GUIDELINES FOR USING THE WETTED PERIMETER
(WETP) COMPUTER PROGRAM
OF THE
MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

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INTRODUCTION

The wetted perimeter and discharge relationships for selected channel cross-sections are a useful tool for deriving instream flow recommendations for the rivers and streams of Montana. Wetted perimeter is the distance along the bottom and sides of a channel cross-section in contact with water (Figure 1). As the discharge in a stream channel decreases, the wetted perimeter also decreases, but the rate of loss of wetted perimeter is not constant throughout the entire range of discharges. Starting at zero discharge, wetted perimeter increases rapidly for small increases in discharge up to the point where the stream channel nears its maximum width. Beyond this break or inflection point, the increase of wetted perimeter is less rapid as discharge increases. An example of a wetted perimeter-discharge relationship showing a well-defined inflection point is given in Figure 2. The instream flow recommendation is selected at or near this inflection point.

The MDFWP developed in 1980 a relatively simple wetted perimeter predictive (WETP) computer model for use in its instream flow program. This model eliminates the relatively complex data collecting and calibrating procedures associated with the hydraulic simulation computer models in current use while providing more accurate and reliable wetted perimeter predictions.

The WETP computer program was written by Dr. Dalton Burkhalter, aquatic consultant, 1429 S. 5th Ave., Bozeman, Montana 59715. The program is written in FORTRAN IV and is located at the computer center, Montana State University, Bozeman. Direct all correspondence concerning the program to Fred Nelson, Montana Department of Fish, Wildlife and Parks, 8695 Huffine Lane, Bozeman, Montana 59715.

DERIVING RECOMMENDATIONS USING WETTED PERIMETER

When formulating flow recommendations for a waterway, the annual flow cycle is divided into two separate periods. They consist of a relatively brief runoff or high flow period, when a large percentage of the annual water yield is passed through the system, and a nonrunoff or low flow period, which is characterized by relatively stable base flows maintained primarily by groundwater outflow. For headwater rivers and streams, the high flow period generally includes the months of May, June and July while the remaining months encompass the low flow period.

Separate instream flow methods are applied to each period. Further, it is necessary to classify a waterway as a stream or river and to use a somewhat different approach when deriving low flow recommendations for each. A waterway is considered a stream if the mean annual flow is less than approximately 200 cfs.

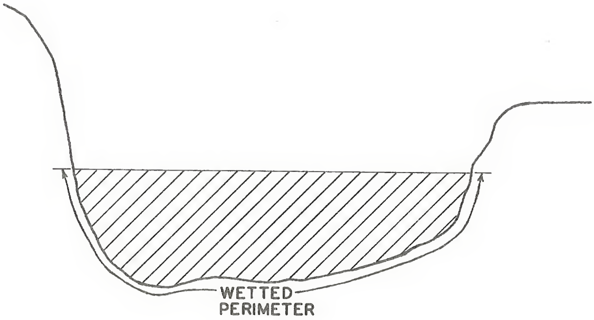

Figure 1. The wetted perimeter in a channel cross-section.

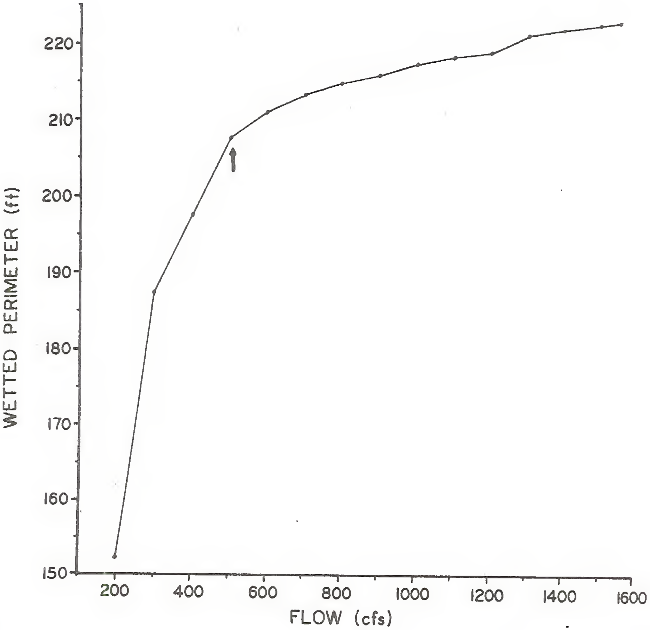

Figure 2. An example of a relationship between wetted perimeter and flow for a riffle cross-section.

Method for the Low Flow Period - Streams

The wetted perimeter/inflection point method is presently the primary method being used by the MDFWP for deriving low flow recommendations for streams. This method is primarily based on the assumption that the food supply is a major factor influencing a stream's carrying capacity (the numbers and pounds of fish that can be maintained indefinitely by the aquatic habitat). The principal food of many of the juvenile and adult game fish inhabiting the streams of Montana is aquatic invertebrates, which are primarily produced in stream riffle areas. The method assumes that the game fish carrying capacity is proportional to food production, which in turn is proportional to the wetted perimeter in riffle areas. This method is a slightly modified version of the Washington Method (Collings, 1972 and 1974), which is based on the premise that the rearing of juvenile salmon is proportional to food production and in turn is proportional to the wetted perimeter in riffle areas. The Idaho Method (White and Cochnauer, 1975 and White, 1976) is also based on a similar premise.

The plot of wetted perimeter versus flow for stream riffle cross-sections generally shows two inflection points, the uppermost being the more prominant. In the example (Figure 3), these inflection points occur at approximate flows of 8 and 12 cfs. Beyond the upper inflection point, large changes in flow cause only very small changes in wetted perimeter. The area available for food production is considered near optimal beyond this point. At flows below the upper inflection point, the stream begins to pull away from the riffle bottom until, at the lower inflection point, the rate of loss of wetted perimeter begins to rapidly accelerate. Once flows are reduced below the lower inflection point, the riffle bottom is being exposed at an accelerated rate and the area available for food production greatly diminishes.

The wetted perimeter-flow relationship may also provide an index of other limiting factors that influence a stream's carrying capacity. One such factor is cover. Cover, or shelter, has long been recognized as one of the basic and essential components of fish habitat. Cover serves as a means for avoiding predators and provides areas of moderate current speed used as resting and holding areas by fish. It is fairly well documented that cover improvements will normally increase the carrying capacity of streams, especially for larger size fish. Cover can be significantly influenced by streamflow.

In the headwater streams of Montana, overhanging and submerged bank vegetation are important components of cover. The wetted perimeter-flow relationship for a stream channel may bear some similarity to the relationship between bank cover and flow. At the upper inflection point, the water begins to pull away from the banks, bank cover diminishes and the stream's carrying capacity declines. Flows exceeding the upper inflection point are considered to provide near optimal bank cover. At flows below the lower inflection point, the water is sufficiently removed from the bank cover to severely reduce its value as fish shelter.

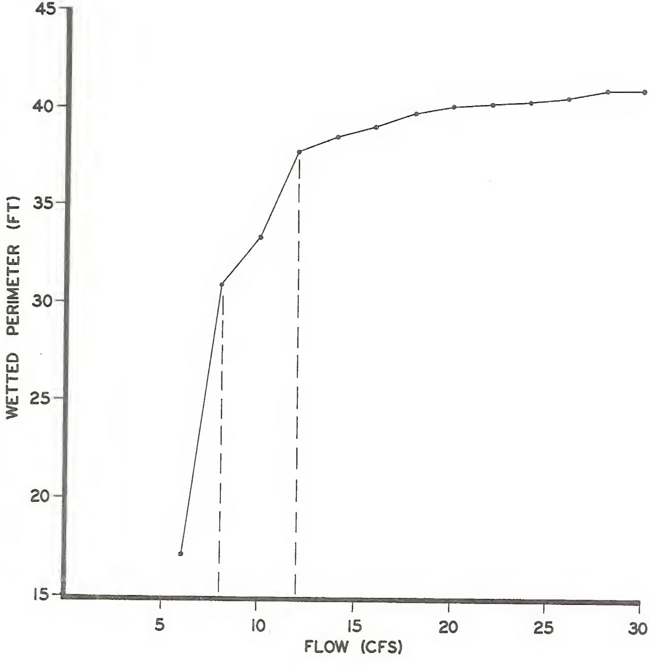

Figure 3. An example of a relationship between wetted perimeter and flow for a riffle cross-section.

It has been demonstrated that riffles are also critical areas for spawning sites of brown trout and shallow inshore areas are required for the rearing of brown and rainbow trout fry (Sando, 1981). It is therefore assumed that, in addition to maximizing bank cover and food production, the flows exceeding the upper inflection point would also provide the most favorable spawning and rearing conditions.

Riffles are the area of a stream most affected by flow reductions (Bovee, 1974 and Nelson, 1977). Consequently, the flows that maintain suitable riffle conditions will also maintain suitable conditions in pools and runs, areas normally inhabited by adult fish. Because riffles are the habitat most affected by flow reductions and are essential for the well-being of both resident and migratory fish populations, they should receive the highest priority for instream protection.

The wetted perimeter/inflection point method provides a range of flows (between the lower and upper inflection points) from which a single instream flow recommendation can be selected. Flows below the lower inflection point are judged undesirable based on their probable impacts on food production, bank cover and spawning and rearing habitat, while flows exceeding the upper inflection point are considered to provide a near optimal habitat for fish. The lower and upper inflection points are believed to bracket those flows needed to maintain the low and high levels of aquatic habitat potential. These flow levels are defined as follows:

1. High Level of Aquatic Habitat Potential - That flow regime which will consistently produce abundant, healthy and thriving aquatic populations. In the case of game fish species, these flows would produce abundant game fish populations capable of sustaining a good to excellent sport fishery for the size of stream involved. For rare, threatened or endangered species, flows to accomplish the high level of aquatic habitat maintenance would: 1) provide the high population levels needed to ensure the continued existence of that species, or 2) provide the flow levels above those which would adversely affect the species.

2. Low Level of Aquatic Habitat Potential - Flows to accomplish a low level of aquatic habitat maintenance would provide for only a low population of the species present. In the case of game fish species, a poor sport fishery could still be provided. For rare, threatened or endangered species, their populations would exist at low or marginal levels. In some cases, this flow level would not be sufficient to maintain certain species.

The final flow recommendation is selected from this range of flows by the fishery biologist who collected, summarized and analyzed all relevant field data for the streams of interest. The biologist's rating of the stream resource forms the basis of the flow selection process. Factors considered in the evaluation include the level of recreational use, the existing level of

environmental degradation, water availability and the magnitude and composition of existing fish populations. The fish population information, which is essential for all streams, is a major consideration. A nonexistent or poor fishery would likely justify a flow recommendation at or near the lower inflection point unless other considerations, such as the presence of species of special concern (arctic grayling and cutthroat trout, for example), warrant a higher flow. In general, only streams with exceptional resident fish populations or those providing crucial spawning and/or rearing habitat for migratory populations would be considered for a recommendation at or near the upper inflection point. The process of deriving the flow recommendation for the low flow period thusly combines a field methodolgy (wetted perimeter/inflection point method) with a thorough evaluation by a field biologist of the existing stream resource.

It is recommended that at least three and preferably five riffle cross-sections are used in the analysis. The final flow recommendation is derived by averaging the recommendations for each cross-section, or the computed wetted perimeters for all riffle cross-sections at each flow of interest averaged and the recommendation selected from the wetted perimeter-flow relationship for the composite of all cross-sections. The latter method is preferred.

While the underlying assumptions of the wetted perimeter/inflection point method appear valid, it cannot yet be said that the method enables the biologist to accurately predict the effects of flow reductions on the fish standing crops and the carrying capacity of the aquatic habitat. Presently, a study evaluating the method for small trout streams is being completed at the Cooperative Fisheries Research Unit, Montana State University, as a thesis project. An innovative approach in which stream sections are isolated with weirs and wild rainbow trout added during the high flow period, saturating the habitat, is used. Changes in carrying capacity, as determined by the movement of trout out of the sections, are measured as the flow decreases. Preliminary study results support the use of riffle wetted perimeter as a reliable index of carrying capacity.

Method for Low Flow Period - Rivers

The Montana Department of Fish, Wildlife and Parks completed a study in 1980 that validated the wetted perimeter method as applied to the trout rivers of southwest Montana (Nelson, 1980a, 1980b and 1980c). In this study, the actual trout standing crop and flow relationship were derived from long-term data collected for five reaches of the Madison, Gallatin, Big Hole and Beaverhead Rivers, all nationally acclaimed wild trout fisheries. These relationships provided a range of flow recommendations for each reach. Flows less that the lower limit were judged undesirable since they led to substantial reductions of the standing crops of adult trout or the standing crops of a particular group of adults, such as trophy-size trout. Flows greater than the upper limit supported the highest adult standing crops during the study period.

Flows between the lower and upper limits are broadly defined as those flows supporting intermediate standing crops or those standing crops that normally occur within each reach. The final recommendation was selected from this range of flows.

The range of flows derived from the trout-flow relationships for the five river reaches were compared to those derived from the wetted perimeter method as applied to riffle areas. The study results showed that the inflection point flows had a somewhat different impact on the trout standing crops of rivers than previously assumed for streams. For rivers, the flow at the upper inflection point is a fairly reliable estimate of the lower limit of the range of flows derived from the trout-flow relationships or, in other terms, flows less than the upper inflection point are undesirable as recommendations since they appear to lead to substantial reductions of the standing crops of adult trout.

The flow at the upper inflection point is not necessarily the preferred recommendation for all trout rivers. The "Blue Ribbon" rivers may require a higher flow in order to maintain the sport fishery resource at the existing level. In general, flows less than the upper inflection point are undesirable as flow recommendations regardless of the rating of the river resource.

DESCRIPTION OF THE WETP PROGRAM

The WETP program uses at least two sets of stage (water surface elevation) measurements taken at different known discharges (flows) to establish a least-squares fit of log-stage versus log-discharge. Once the stage-discharge rating curve for each cross-section is determined, the stage at a flow of interest can be predicted. This rating curve, when coupled with the cross-sectional profile, is all that is needed to predict the wetted perimeter at most flows of interest.

The program should be run using three sets of stage-discharge data collected at a high, intermediate and low flow. Additional data sets are desirable, but not necessary. The three measurements are made when runoff is receding (high flow), near the end of runoff (intermediate flow) and during late summer-early fall (low flow). The high flow should be considerably less than the bankfull flow, while the low flow should approximate the lowest flow that normally occurs during the summer-fall field season. Sufficient spread between the highest and lowest calibration flows is needed in order for the program to compute a linear, sloping rating curve (Figure 4).

The WETP program can be run using only two sets of stage-discharge data. This practice is not recommended since substantial "two-point" error can result. However, when only two data sets are obtainable, the higher discharge should be at least twice as high as the lower discharge.

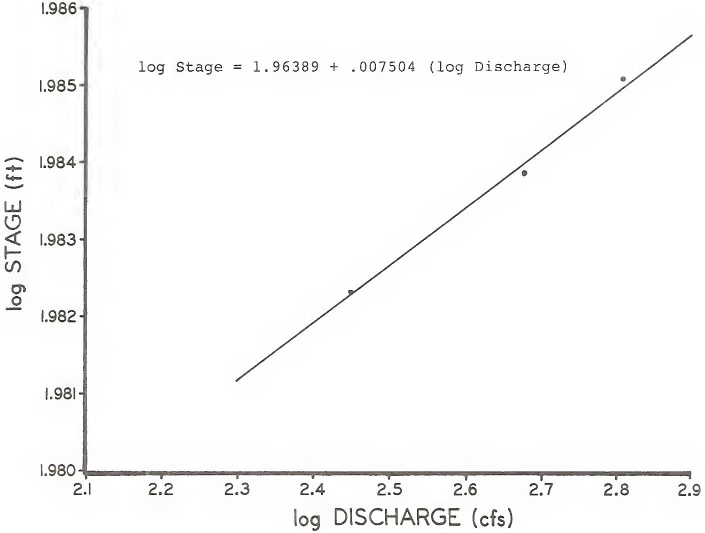

Figure 4. An example of a "three point" stage-discharge rating curve for a riffle cross-section.

In addition to wetted perimeter (WETP), the program also predicts other hydraulic characteristics that can be used in deriving flow recommendations for selected time periods. These are the mean depth (DBAR) in ft, mean velocity (VBAR) in ft/sec, top width (WDTH) in ft, cross-sectional area (AREA) in ft^2, stage (STGE) in ft, and maximum depth (DMAX) in ft.

A useful program option, termed the width-at-given-depth (WAGD) option, will calculate for up to 10 given depths the width (in ft) and percentage of the top width having depths greater than or equal to the given values. The width and percentage of the longest, continuous segment having the required depths is also listed for each flow of interest.

FIELD DATA REQUIREMENTS

The required inputs to the WETP program for each cross-section are:

1. Three sets of stage-discharge data measured at a high, intermediate and low flow. Two sets will satisfy the program requirements; however, a minimum of three is recommended.

2. The cross-sectional profile which consists of channel elevations (vertical distances) and the horizontal distance of each elevation measurement from the headstake (zero point). Up to 150 sets of measurements per cross-section are accepted by the program.

The following are needed to document field work:

1. Labeled slides or photographs of the study area and cross-sections at the time field data are collected.

2. Field notebooks containing all surveying data, notes and calculations, recorded in a neat, consistent manner.

FIELD METHODS

Equipment

1. Level (a self-leveling or automatic level such as a Wild NAK1 is preferred).

2. 25-ft, telescoping, fiberglas level rod.

3. 100-500 ft canyon line or other suitable measuring tape.

4. Rebar cut in 30-inch pieces (stakes). Two stakes are needed per cross-section.

5. Two clamps (modified vise grips with flat jaws).

6. Engineers field notebook.

7. Pencils.

8. Current meter and rod, stopwatch and beeper box. Gurley or Price AA current meters are preferred. A Marsh-McBirney instantaneous readout current meter can be used in place of a Gurley or Price AA meter, provided the instantaneous meter is correctly calibrated.

9. Small sledge hammer.

10. Camera.

11. Fluorescent spray paint and flagging.

Selecting Study Areas and Placing Cross-sections

Follow these guidelines when selecting study areas and placing cross-sections.

1. It is best to locate study areas and stake cross-sections during low water prior to the onset of runoff. It will be difficult to select these sites during the high water period when data collection begins.

2. Place the cross-sections in riffle areas if the wetted perimeter/inflection point method will be used to derive recommendations. Other critical habitat types can also be used, depending on your chosen methodology.

3. Describe the riffles using 3 to 10 cross-sections. It is recommended that at least 3 and preferably 5 riffle cross-sections are used. The program accepts 1 to 10 cross-sections per study area.

4. The WETP model assumes that the water surface elevations at the water's edge on the left bank (WEL) and right bank (WER) of a cross-section are always equal at a given flow. This is a valid assumption since the water surface elevations at WEL and WER generally remain within 0.1 ft of each other as the flow changes, provided the water surface elevations at WEL and WER were matched when the cross-section was established. Avoid placing cross-sections in areas where this assumption is likely to be violated, such as sharp bends in rivers and multiple channels containing islands. If cross-sections through these areas are unavoidable, you should proceed with caution.

5. Place the headstake marking each cross-section well up on the bank. Drive the headstake almost flush with the ground and mark well. In addition to marking the cross-section, the headstake is also your zero reference point for measuring horizontal distances across the

cross-section. Headstakes for all the cross-sections within a study area should be located on the same bank.

Another stake is driven directly across from the headstake on the opposite bank. Place this stake so that the water surface elevations at the WEL and WER of the established cross-section are equal or similar. This will require the use of a level rod. This stake is used to mark the cross-section on the bank opposite the headstake and also to attach the measuring tape when the channel profile is measured, so should not be driven to ground level.

6. Number the cross-sections consecutively from downstream to upstream (the downstream most cross-section is #1).

7. Measure the distances between cross-sections. This is an optional measurement that might be useful in locating cross-sections during return trips.

8. Remember, the WETP model is invalidated if channel changes occur in the study area during the data collecting process. For this reason, the collection of all field data should be completed during the period beginning when runoff is receding and ending with the onset of runoff the following year. The stream channel is expected to be stable during this period.

Establishing Bench Marks

Establish a bench mark at or near your study area. The bench mark is a point that will not be disturbed or moved. A nail driven into the base of a tree, a fixed spot on a bridge abutment and a survey stake driven into the ground are examples of bench marks. Bench marks should be well marked and described in your field notebook so they can be easily located. All channel and water surface elevations are established relative to the bench mark, which is assigned an elevation of 100.00 or 10.00 ft.

For streams having "heavy" vegetative cover, the use of a single bench mark may not be practical. In this case, the individual headstakes can be used as bench marks. For example, the headstake for cross-section #1 could serve as the bench mark for cross-sections #1 and 2, while the headstake for cross-section #3 could serve as the bench mark for cross-sections #3, 4 and 5. Each headstake could also serve as the bench mark for that individual cross-section. While this is not the best surveying technique, certain stream reaches may require its use. Be sure to carefully record in your notebook which headstakes are used as bench marks to avoid confusion and errors on return trips.

Surveying Techniques

The reader is referred to Spence (1975) and Bovee and Milhous (1978) for a discussion of the surveying techniques used to measure cross-sectional profiles and water surface elevations. Both papers should be read by those unfamiliar with the mechanics of surveying. All investigators must receive field training before attempting any measurements.

It is important to be consistent and to use good technique when collecting and recording data. Record all data in your notebook and complete all calculations while in the field, so that any surveying errors can be detected and corrected. Remember, your field notebooks may be examined in court or hearing proceedings. Good quality equipment such as an automatic level is also an asset.

Measuring Water Surface Elevations (Stages)

Water surface elevations should be measured for each cross-section at three different flows. If cross-sections are established prior to runoff, then you must return to the study area at least three more times, when runoff is receding (high flow), near the end of runoff (intermediate flow) and during late summer or early fall (low flow).

It should be noted that it is unnecessary to collect surface elevation measurements for all of the cross-sections within a study area at the same flows. For example, if another cross-section is added to the study area at a later date, the calibration flows for this new cross-section do not have to match those for the remaining cross-sections. It is also unnecessary to have the same number of calibration flows for all of the cross-sections within a study area.

Water surface elevations are measured at the water's edge directly opposite the stake marking the cross-section on each bank. The stretching of a tape across the cross-section is unnecesary, since the horizontal distances from the headstake to the WEL and WER are not needed. Measure water surface elevations to the nearest 0.01 ft. The mechanics of this measurement are discussed in Bovee and Milhous (1978). Once water surface elevations are calculated, repeat the measurements and check for surveying errors. If a single bench mark is used, then water surface elevations should increase with the upstream progression of cross-sections.

As previously discussed, the WETP model assumes that the water surface elevations at WEL and WER are always equal at a selected flow of interest. In a stream channel, the surface elevations at the WEL and WER of a cross-section should remain fairly equal as the flow varies, provided the elevations at WEL and WER were matched when the cross-section was established. Consequently, it is necessary to measure the water surface elevations at both WEL and WER during all return trips to verify this assumption. These two measurements

should always be within approximately 0.1 ft of one another. For the larger waterways, an approximate 0.2 - 0.3 ft difference is allowable. Average these two measurements to obtain the water surface elevation that is entered in the WETP program.

Measuring Stream Discharges

The flow through the study area must be measured each time water surface elevations are determined. On the larger waterways, it is best to locate study areas near USGS gage stations to eliminate a discharge measurement.

Use standard USGS methods when measuring discharges. Publications of Bovee and Milhous (1978), Buchanan and Somers (1969), and Smoot and Novak (1968) describe these methods and provide information on the maintenance of current meters. Read these publications before attempting any discharge measurements. Field training is also mandatory.

Measuring Cross-sectional Profiles

The channel profile has to be determined for each cross-section. Unlike the measurement of water surface elevations, this has to be done only once. It is best to measure profiles at the lowest calibration flow when wading is easiest. For the unwadable, larger waterways that require the use of a boat, profiles are best measured at an intermediate calibration flow.

For wadable streams, a measuring tape is stretched across the cross-section with the zero point set on top of the headstake. Setting the headstake at zero, while not mandatory, is a good practice that provides consistency in your field technique. Never attach the tape directly to the headstake. The tape is attached with a vise grip to a stake that is driven behind the headstake. A vise grip can be attached directly to the stake on the opposite bank to stretch and hold the tape in place.

Elevations are now measured betweeen the headstake and water's edge using the level rod. Elevations are measured at major breaks in the contour. The horizonatal distance of each elevation measurement from the headstake (zero point) is also recorded. Elevations are also measured between the water's edge at the opposite bank and the opposite stake and the horizontal distance from the headstake recorded for each measurement. Elevations of the exposed portions of instream rocks and boulders are also measured in this manner. Measure elevations to the nearest 0.01 ft and horizontal distances to the nearest 0.1 ft.

Be sure to collect profile measurements for points well above the water's edge. It is a good practice, although not mandatory, to begin at the headstake (0.0 distance) and end at the stake on the opposite bank. Remember, the highest elevations on both banks of the cross-sectional profile must be

substantially higher than the stage at the highest calibration flow, if predictions are to be made for flows of interest that exceed the highest calibration flow.

For the segment of the cross-section containing water, a different approach involving the measurement of water depth is used. Water depth is measured using a current meter rod. Do not use your level rod. Measure depths at all major breaks in the bottom contour. Generally, 10-30 depth measurements are needed for streams and creeks. Measure depths to the nearest 0.1 ft. For each depth measurement, record the horizontal distance from the headstake (zero point). The bottom elevation at each distance from the headstake is determined by subtracting the water depth from the water surface elevation (average for WEL and WER). For example, if the average water surface elevation is 95.26 ft and at 3.2 ft from the headstake the water depth is 1.9 ft, then the bottom elevation at this distance is 93.36 ft (95.26 ft minus 1.9 ft). The elevations for all points covered by water are calculated in this manner.

For the unwadable, larger waterways, cross-sectional profiles are measured using a boat, depth recorder and range finder. Graham and Penkal (1978) describe this technique.

The WETP program will handle vertical banks. When recording these data, the horizontal distance from the headstake to both the top and bottom of the vertical will be the same, but the elevations will be different.

The program <u>will not</u> handle undercut banks. These data have to be adjusted before being entered on the coding sheets. The best method is to treat undercuts as vertical banks. To accomplish this, the horizontal distance from the headstake to the bottom of the undercut is substituted for the horizontal distance to the top of the undercut, creating a vertical bank.

The program will handle islands, bars and multiple channels, provided the water surface elevations at all the water's edges of the cross-section remain relatively equal as the total stream flow changes. Since this is unlikely, these areas should be avoided when establishing cross-sections.

OFFICE METHODS

WETP Data Format

An example describing the WETP format is given in Appendix A. Much of the format is self-explanatory. Carefully examine this example and the explanatory notations before attempting to code your data on the coding sheets.

Enter the WETP data on the coding sheets in the following manner:

1. Flows of interest (up to 100 flows are accepted by the program)

   Integers in cfs or with decimal points (not to exceed six characters, including decimal point, if used)

2. Cross-sectional profile (up to 150 sets of measurements are accepted)

   Distances from headstake - nearest 0.1 ft
   Channel elevations - nearest 0.01 ft

3. Stage-discharge data (2 to 10 sets of measurements are accepted)

   Stages (water surface elevations) - nearest 0.01 ft
   Discharges (flows) - nearest 0.1 cfs

If the cross-sectional profile and stage-discharge data are entered in the above manner, decimal points are not needed. However, decimal points can be used if desired.

Selecting Flows of Interest

You will be extrapolating data for flows of interest that are less than the lowest measured calibration flow for a particular cross-section. The extrapolation of data beyond the highest calibration flow is a less desirable option since our main interest is to derive minimum flow recommendations. Remember, the stage-discharge rating curve generally flattens out at extremely high (above bankfull) and extremely low flows. At these flows, the predicted stages from the measured rating curve are inaccurate and will lead to inaccurate hydraulic predictions.

Use the following guidelines when selecting flows of interest (Bovee and Milhous, 1978):

1. Two point stage-discharge rating curve

   Hydraulic predictions should not be made for flows which are less than 0.77 times the minimum measured flow, nor for flows higher than 1.3 times the maximum measured flow.

2. Three point (or greater) stage-discharge rating curve

   Hydraulic predictions should not be made for flows which are less than 0.4 times the minimum measured flow, nor for flows higher than 2.5 times the maximum measured flow.

WETP Data Output

The output for the input example in Appendix A is given in Appendix B. Carefully examine this output.

When reviewing your outputs, consider the following:

1. Errors

   Carefully check the profile and stage-discharge data on the printouts for errors. The keypunch operators occasionally make errors, even though they carefully proof the data files. The vast majority of errors, however, are the result of format and recording errors on the coding sheets. If corrections are needed, mark all changes on the coding sheets in red ink or pencil and return to Fred Nelson so the file can be corrected and your data rerun.

2. Error messages

   The vast majority of error messages that occasionally appear on the printouts are a result of undetected format errors on the coding sheets. These are easily corrected and the file rerun before the printout is sent to the cooperator.

   An error message will appear when predictions are requested for flows of interest having stages higher than the highest elevations in the cross-sectional profile. Additional profile measurements collected higher up on the banks will correct this problem, if deemed necessary.

3. r^2 values

   If the r^2 value for a stage-discharge rating curve is less than approximately 0.90, the cross-section should be eliminated from the analysis. Low r^2 values may be due to errors, so recheck the stage and discharge measurements before eliminating these cross-sections. For those cross-sections having only two sets of stage-discharge measurements, r^2 values are automatically 1.00 and consequently of no use in assessing the reliability of the hydraulic predictions.

OTHER USES FOR THE WETP OUTPUT

The wetted perimeter/inflection point method, as previously described, is the primary method the MDFWP is presently using to derive instream flow recommendations for the waterways of Montana. The WETP program and output can also be used in other ways for deriving recommendations. Some of these uses are discussed in the following examples.

Passage of Migratory Trout

Many streams, particularly those in northwest Montana, provide important spawning and rearing habitats for migratory salmonids. Sufficient stream flows are needed not only to maintain the spawning and rearing habitats, but also to pass adults through shallow riffle areas and other natural barriers while moving to their upstream spawning areas.

Trout passage criteria relating to stream depth have been developed in Oregon and Colorado (Table 1). These criteria, when used in conjunction with the WETP output for critical riffle areas, can be used to derive minimum passage flows.

Table 1. Trout passage criteria (from Wesche and Rechard, 1980).

Species	Source	Minimum Depth (ft)	Average Depth (ft)	Where Developed
Large Trout ≧20 inches	Thompson 1972	0.6	---	Oregon
Other Trout <20 inches	Thompson 1972	0.4	---	Oregon
Trout (on streams 20 ft or greater)	Colo. Div. of Wild. 1976	---	0.5-0.6 across riffles	Colorado
Trout (on streams 10-20 ft wide)	Colo. Div. of Wild. 1976	---	0.2-0.4 across riffles	Colorado

For example, passage criteria developed by the Colorado Division of Wildlife for streams 20 ft and wider indicate that the minimum average depth needed to pass trout through riffles is 0.5-0.6 ft. The output for the Tobacco River (Table 2) shows that the average depth for all five riffle cross-sections exceeds 0.5 ft, the approximate minimum average depth required for passage, at a flow of approximately 120 cfs. A flow of at least 120 cfs is therefore recommended during the spawning period to facilitate the passage of adult trout to upstream spawning areas.

Table 2. Average depths for five riffle cross-sections in the Tobacco River, Montana, at selected flows of interest. Average depths were derived using the WETP computer program.

	Average Depth (ft)				
Flow (cfs)	Riffle cs #1	Riffle cs #2	Riffle cs #3	Riffle cs #4	Riffle cs #5
100	.44	.65	.79	.68	.47
110	.49	.69	.85	.72	.52
120	.54	.73	.91	.75	.57

The minimum depth criteria developed in Oregon could also be used in conjunction with the WAGD option of the WETP program to derive recommendations. For this evaluation, criteria are developed requiring at least a certain percentage of the top width of a cross-section to have water depths greater than or equal to the minimum needed for fish passage. In Oregon, at least 25% of the top width and a continuous portion equaling at least 10% of the top width are used (Thompson, 1972). The flow that satisfies these criteria for all cross-sections is recommended.

Goose Nesting Requirement

The maintenance of adequate flows around islands selected by Canada geese for nesting is necessary to insure that the nests are protected from mammalian predators. Under low flow conditions, these predators have easy access to the islands and can significantly reduce goose production. The security of the islands is a primary factor in their selection as nest sites by geese. This security is provided by adequate side channel flows, which are a function of depth, width, and velocity. Since wetted perimeter is a function of both width and depth, its relationship to discharge is believed to be the best indicator of the minimum flows that are needed to maintain secure nesting islands.

The wetted perimeter/inflection point method is applied to the shallowest area of the side channel bordering each nesting island. A wetted perimeter-side channel discharge curve is generated for each cross-section and the inflection point determined. A curve correlating the side channel flow to the total river flow is also derived during the field season. From these curves, the total river discharge that would provide the inflection point flow in each side channel is determined. The final recommendation is derived by averaging the recommendations for each island or choosing the river flow that would maintain at least the inflection point flow around all the islands being sampled in the study area. The latter method is preferred.

Depth and width criteria could also be developed and used in conjunction with the WAGD option of the WETP program to formulate flow recommendations for nesting.

Maintenance of Spawning and Rearing Habitats in Side Channels

Side channels provide important and sometimes critical spawning and rearing habitats for many cold and warm water fish species. The maintenance of these habitats is dependent on adequate side channel flows.

The wetted perimeter/inflection point method, when applied to the riffle areas of critical side channels, will provide a measure of the side channel flow that is needed to maintain the spawning and rearing habitats at acceptable levels. When this side channel recommendation is used in conjunction with a curve correlating the side channel flow to the total river flow, the total river flow that would maintain adequate side channel flow can be determined.

This method is applied to a series of side channels and the final recommendation derived by averaging the recommendations for each or choosing the river flow that would maintain at least the inflection point flow in all the sampled side channels. The latter method is again preferred.

Recreational Floating Requirement

Minimum depth and width criteria have been developed for various types of boating craft by the Cooperative Instream Flow Service Group of the U.S. Fish and Wildlife Service (Hyra, 1978). These are listed in Table 3.

Table 3. Required stream width and depth for various recreation craft.

Recreation Craft	Required Depth (ft)	Required Width (ft)
Canoe-kayak	0.5	4
Drift boat, row boat-raft	1.0	6
Tube	1.0	4
Power boat	3.0	6
Sail boat	3.0	25

These criteria are minimal and would not provide a satisfactory experience if the entire river was at this level. However, if the required depths and widths are maintained in riffles and other shallow areas, then these minimum conditions will only be encountered a short time during the float and the remainder of the trip will be over water of greater depths.

Cross-sections are placed in the shallowest area along the waterway. The WAGD option of the WETP program is used to determine the flow that will satisfy the minimum criteria for the craft of interest. For example, if deriving a recommendation for power boats, the flow providing depths $\geq$ 3.0 ft for at

least a 6.0 ft, continuous length of top width is recommended. When a series of cross-sections are used, the results for each cross-section are analyzed separately and the flow satisfying the criteria for all cross-sections is recommended.

This analysis can be expanded using additional criteria. For example, in addition to the above criteria for power boats, it can also be required that a certain percentage of the top width, such as 25%, has depths $\geq$ 3.0 ft. Remember, you will have to justify all criteria used in your analysis.

FINAL CONSIDERATIONS

Be sure to compare your instream flow recommendations to the water availability. For gaged streams, many summary flow statistics, such as the mean and median monthly flow of record, are available for comparison. For ungaged streams, instantaneous flow measurements collected by various state and federal agencies and simulated data are useful. The primary purpose is to determine if the recommendation is reasonable based on water availability. It is also desirable, for future planning, to define the period in which water in excess of the recommendation is available for consumptive uses and to quantify this excess.

It is common for the low flow recommendations for many of the headwater rivers and streams to equal or exceed the normal water availability for the months of November through March. This is the winter period when the natural flows are lowest for the year. These naturally occurring low flows, when coupled with the adverse effects of surface and anchor ice formation and the resulting scouring of the channel at ice-out, can impact the fishery. Consequently, water depletions during the winter have the potential to be extremely harmful to the already stressed fish populations. For headwater rivers and streams, it is generally accepted that little or no water should be removed during the critical winter period if fish populations are to be maintained at existing levels.

The recommendations derived from the wetted perimeter/inflection point method only apply to the low flow or nonrunoff months. For the high flow or runoff period, flow recommendations should be based on those flows judged necessary for flushing bottom sediments and maintaining the existing channel morphology. This method, termed the dominant discharge/channel morphology concept (Montana Department of Fish and Game, 1979), requires at least nine years of continuous USGS gage records for deriving high flow recommendations, so cannot be applied to most streams.

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702/G

APPENDIX A

Example of WETP input format

Title and location of study area

IBM FORTRAN Coding Form

GX28-7327-6 U/M 050**
Printed in U.S.A.

PROGRAM: Bear Creek - Big Hole Drainage - SW, SE, Sec. 34, T2N, R12W

PROGRAMMER: Fred Nelson

DATE: 1-31-83

PAGE 1 OF 4

CARD ELECTRO NUMBER*

STATEMENT NUMBER	FORTRAN STATEMENT											
QARD	1.5											
QARD	2											
QARD	2.5											
QARD	3											
QARD	3.5											
QARD	4											
QARD	5											
QARD	6											
QARD	7											
QARD	8											
QARD	9											
QARD	10											
QARD	15											
QARD	20											
QARD	25											
QARD	30											
QARD	40											
QARD	50											
QARD	60											
QARD	70											
XSEC	1											
	1	0	9657	9	9642	15	9600	16	9424	21	9411	30	9389
	1	41	9386	51	9383	60	9363	61	9297	63	9283	64	9273
	1	68	9253	73	9243	78	9233	83	9233	88	9223	93	9233

Flows of interest
Up to 100 flows allowed
Enter as integers or with decimal points

Profile data

Distance from headstake

Channel elevation

Reads as 1.5 ft

Reads as 96.00 ft

Do not enter profile data past space 70

*A standard card form, IBM electro 888157, is available for punching statements from this form.

*Number of forms per pad may vary slightly.

Cross-section identification

IBM FORTRAN Coding Form

GX28-7327-6 U/M 050**
Printed in U.S.A.

PROGRAM: Bear Creek | PROGRAMMER: | PAGE 2 OF 4

Statement Number	FORTRAN Statement													Remarks
	1	98	9238	103	9243	108	9243	113	9243	118	9248	123	9263	
	1	128	9268	133	9273	135	9283	140	9314	150	9330	159	9350	
	1	162	9407	170	9485	182	9502	194	9536					
CAL1	1		9359		334									← Calibration data for CS#1 - high flow
CAL2	1		9321		113									← " " - intermediate flow
CAL3	1		9283		38									← " " - low flow
XSEC	2													
	2	0	9726	4	9719	10	9676	19	9632	20	9463	25	9404	
	2	35	9383	43	9396	44	9357	52	9356	54	9342	63	9342	
	2	75	9332	77	9323	80	9318	85	9313	90	9313	91	9293	
	2	96	9293	101	9293	107	9288	113	9298	117	9293	120	9273	
	2	125	9273	130	9273	135	9273	137	9293	138	9323	139	9393	
	2	140	9435	147	9464	155	9483	158	9515	168	9531	179	9536	
	2	190	9552											
CAL1	2		9390		334									Water surface elevations
CAL2	2		9357		113									Each is the average for the WEL and WER
CAL3	2		9323		38									Without decimal points, reads as 93.90, 93.57 and 93.23 ft
XSEC	3													
	3	0	9799	10	9782	20	9755	29	9724	36	9706	46	9674	
	3	51	9662	52	9602	63	9600	74	9607	81	9618	90	9630	
	3	99	9636	109	9636	118	9619	127	9601	130	9590	133	9585	
	3	138	9575	141	9565	147	9555	150	9550	155	9540	160	9535	
	3	165	9530	170	9515	175	9525	180	9520	185	9515	190	9540	
	3	195	9545	198	9550	199	9590	200	9697	201	9717	210	9709	

**Number of forms per pad may vary slightly

IBM

FORTRAN Coding Form

GX28-7327-6 U/M 050**
Printed in U.S.A.

PROGRAM: Bear Creek

PAGE 3 OF 4

Statement													
	3	195	9545	198	9550	199	9590	200	9697	201	9717	210	9709
	3	220	9707	224	9741	231	9746	240	9748	250	9751		
CAL1	3		9663		334								
CAL2	3		9626		113								
CAL3	3		9590		38								
XSEC	4												
	4	0	9863	10	9848	14	9824	24	9813	34	9809	43	9800
	4	50	9785	60	9766	70	9761	80	9746	90	9734	96	9700
	4	101	9687	108	9673	109	9661	110	9661	116	9661	121	9656
	4	130	9656	140	9656	145	9656	147	9651	153	9646	158	9646
	4	160	9636	165	9626	170	9626	175	9616	185	9626	195	9626
	4	200	9631	205	9636	210	9636	215	9636	220	9641	223	9646
	4	228	9646	234	9651	238	9656	242	9661	244	9666	250	9667
	4	255	9687	261	9717	265	9742	272	9748	278	9763	287	9754
	4	295	9740	310	9743	342	9745	346	9793	353	9829	361	9829
CAL1	4		9714		334								
CAL2	4		9685		113								
CAL3	4		9661		38								
XSEC	5												
	5	0	9830	10	9806	14	9793	16	9769	18	9675	19	9640
	5	22	9625	30	9615	40	9615	50	9625	58	9615	60	9625
	5	65	9620	70	9630	80	9635	90	9635	98	9645	102	9655
	5	105	9675	106	9688	110	9706	119	9690	122	9680	129	9687
	5	135	9705	141	9736	149	9747	152	9775	161	9782	170	9788

} Calibration flows
Without decimal points, reads as 33.4, 11.3 and 3.8 cfs

* Number of forms per pad may vary slightly

IBM

FORTRAN Coding Form

GX28-7327-6 U/M 050**
Printed in U.S.A.

PROGRAM Bear CreeK

PAGE 4 OF 4

FORTRAN STATEMENT

```
      5 180 9777 190 9765 200 9754 215 9748 231 9746 242 9753
      5 244 9809 248 9831 254 9842 265 9842
CAL1  5     9725      334
CAL2  5     9697      113
CAL3  5     9675       38
D .4 1.0
PØØL 1 2 3 4 5
PØØL 3 4 5
```

Optional Entry
In this example, results are also averaged for CS# 3,4 and 5. Use as many PØØL entries as needed.

Mandatory Entry
Prints results for each cross-section as well as the average for all cross-sections.

Width-at-given-depth option
Up to 10 depths allowed. Separate depths of interest with single space. In this example, asking for length of top width having depths ≥ .4 ft and 1.0 ft.

* Number of forms per pad may vary slightly

APPENDIX B

Example of WETP data output

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

PROGRAM WETP

*** MONTANA DEPT. OF FISH, WILDLIFE AND PARKS ***

Program WETP Rev. 1-83 (1 Feb. 1983)

Program WETP calculates the following parameters for a stream cross-section. Up to 10 stream cross-sections may be pooled together to obtain an average of pooled cross-sections. Cross-sections may be defined by up to 150 points.

WETP - wetted perimeter
DBAR - average depth
VBAR - average velocity throughout cross-sectional area
WDTH - top width of cross-section
AREA - cross-sectional area
STGE - water surface elevation
DMAX - maximum depth
WTOT - width at a depth > or = to a given value
WMAX - max. cont. width at a depth > or = to a given value
PTOT - ratio of WTOT/WDTH expressed as a percent
PMAX - ratio of WMAX/WDTH expressed as a percent

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

CROSS-SECTION DATA

1		2		3		4		5							
X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
.0	96.57	.0	97.26	.0	97.99	.0	98.63	.0	98.30						
.9	96.42	.4	97.19	1.0	97.82	1.0	98.48	1.0	98.06						
1.5	96.00	1.0	96.76	2.0	97.55	1.4	98.24	1.4	97.93						
1.6	94.24	1.9	96.32	2.9	97.24	2.4	98.13	1.6	97.69						
2.1	94.11	2.0	94.63	3.6	97.06	3.4	98.09	1.8	96.75						
3.0	93.89	2.5	94.04	4.6	96.74	4.3	98.00	1.9	96.40						
4.1	93.86	3.5	93.83	5.1	96.62	5.0	97.85	2.2	96.25						
5.1	93.83	4.3	93.96	5.2	96.02	6.0	97.66	3.0	96.15						
6.0	93.63	4.4	93.57	6.3	96.00	7.0	97.61	4.0	96.15						
6.1	92.97	5.2	93.56	7.4	96.07	8.0	97.46	5.0	96.25						
6.3	92.83	5.4	93.42	8.1	96.18	9.0	97.34	5.8	96.15						
6.4	92.73	6.3	93.42	9.0	96.30	9.6	97.00	6.0	96.25						
6.8	92.53	7.5	93.32	9.9	96.36	10.1	96.87	6.5	96.20						
7.3	92.43	7.7	93.23	10.9	96.36	10.8	96.73	7.0	96.30						
7.8	92.33	8.0	93.18	11.8	96.19	10.9	96.66	8.0	96.35						
8.3	92.33	8.5	93.13	12.7	96.01	11.0	96.61	9.0	96.35						
8.8	92.23	9.0	93.13	13.0	95.90	11.6	96.61	9.8	96.45						
9.3	92.33	9.1	92.93	13.3	95.85	12.1	96.56	10.2	96.55						
9.8	92.38	9.6	92.93	13.8	95.75	13.0	96.56	10.5	96.75						
10.3	92.43	10.1	92.93	14.1	95.65	14.0	96.56	10.6	96.88						
10.8	92.43	10.7	92.88	14.7	95.55	14.5	96.56	11.0	97.06						
11.3	92.43	11.3	92.98	15.0	95.50	14.7	96.51	11.9	96.90						
11.8	92.48	11.7	92.93	15.5	95.40	15.3	96.46	12.2	96.80						
12.3	92.63	12.0	92.73	16.0	95.35	15.8	96.46	12.9	96.87						
12.8	92.68	12.5	92.73	16.5	95.30	16.0	96.36	13.5	97.05						
13.3	92.73	13.0	92.73	17.0	95.15	16.5	96.26	14.1	97.36						
13.5	92.83	13.5	92.73	17.5	95.25	17.0	96.26	14.9	97.47						
14.0	93.14	13.7	92.93	18.0	95.20	17.5	96.16	15.2	97.75						
15.0	93.30	13.8	93.23	18.5	95.15	18.5	96.26	16.1	97.82						
15.9	93.50	13.9	93.93	19.0	95.40	19.5	96.26	17.0	97.88						
16.2	94.07	14.0	94.35	19.5	95.45	20.0	96.31	18.0	97.77						
17.0	94.85	14.7	94.64	19.8	95.50	20.5	96.36	19.0	97.65						
18.2	95.02	15.5	94.83	19.9	95.90	21.0	96.36	20.0	97.54						
19.4	95.36	15.8	95.15	20.0	96.97	21.5	96.36	21.5	97.48						
.0	.00	16.8	95.31	20.1	97.17	22.0	96.41	23.1	97.46						
.0	.00	17.9	95.36	21.0	97.09	22.3	96.46	24.2	97.53						
.0	.00	19.0	95.52	22.0	97.07	22.8	96.46	24.4	98.09						
.0	.00	.0	.00	22.4	97.41	23.4	96.51	24.8	98.31						
.0	.00	.0	.00	23.1	97.46	23.8	96.56	25.4	98.42						
.0	.00	.0	.00	24.0	97.48	24.2	96.61	26.5	98.42						
.0	.00	.0	.00	25.0	97.51	24.4	96.66	.0	.00						
.0	.00	.0	.00	.0	.00	25.0	96.67	.0	.00						
.0	.00	.0	.00	.0	.00	25.5	96.87	.0	.00						
.0	.00	.0	.00	.0	.00	26.1	97.17	.0	.00						
.0	.00	.0	.00	.0	.00	26.5	97.42	.0	.00						
.0	.00	.0	.00	.0	.00	27.2	97.48	.0	.00						
.0	.00	.0	.00	.0	.00	27.8	97.63	.0	.00						

BEAR CREEK - BIG HOLE DRAINAGE - SW, SE, SEC 34, T2N, R12W

.0	.00	.0	.00	.0	.00	28.7	97.54	.0	.00
.0	.00	.0	.00	.0	.00	29.5	97.40	.0	.00
.0	.00	.0	.00	.0	.00	31.0	97.43	.0	.00
.0	.00	.0	.00	.0	.00	34.2	97.45	.0	.00
.0	.00	.0	.00	.0	.00	34.6	97.93	.0	.00
.0	.00	.0	.00	.0	.00	35.3	98.29	.0	.00
.0	.00	.0	.00	.0	.00	36.1	98.29	.0	.00

CALIBRATION DATA

1		2		3		4		5							
Q	S	Q	S	Q	S	Q	S	Q	S	Q	S	Q	S	Q	S
33.4	93.59	33.4	93.90	33.4	96.63	33.4	97.14	33.4	97.25						
11.3	93.21	11.3	93.57	11.3	96.26	11.3	96.85	11.3	96.97						
3.8	92.83	3.8	93.23	3.8	95.90	3.8	96.61	3.8	96.75						

REGRESSION CURVE CONSTANTS

CONSTANTS AND R-SQUARED VALUES ARE GIVEN FOR THE
REGRESSION LOG S = A + B * LOG Q

1		2		3		4		5							
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1.966	.004	1.968	.003	1.980	.003	1.984	.003	1.984	.002						
R2		R2		R2		R2		R2		R2		R2		R2	
1.000		1.000		1.000		.997		.995							

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

COMPUTED VALUES

FLOW= 1.5 CFS

XSEC		1	2	3	4	5						AVG
WETP		5.02	4.32	5.54	5.72	8.45	.00	.00	.00	.00	.00	5.81
DBAR		.13	.11	.26	.09	.26	.00	.00	.00	.00	.00	.17
VBAR		2.40	3.42	1.10	2.79	.70	.00	.00	.00	.00	.00	2.08
WDTH		4.97	4.14	5.35	5.69	8.24	.00	.00	.00	.00	.00	5.68
AREA		.62	.44	1.37	.54	2.14	.00	.00	.00	.00	.00	1.02
STGE		92.51	92.95	95.59	96.38	96.53	.00	.00	.00	.00	.00	94.79
DMAX		.28	.22	.44	.22	.38	.00	.00	.00	.00	.00	.30
WTOT	.4	.00	.00	.77	.00	.00	.00	.00	.00	.00	.00	.15
WMAX		.00	.00	.45	.00	.00	.00	.00	.00	.00	.00	.09
PTOT		.00	.00	14.34	.00	.00	.00	.00	.00	.00	.00	2.87
PMAX		.00	.00	8.46	.00	.00	.00	.00	.00	.00	.00	1.69
WTOT	1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 2.0 CFS

XSEC		1	2	3	4	5						AVG
WETP		5.66	4.98	6.13	6.44	8.69	.00	.00	.00	.00	.00	6.38
DBAR		.21	.18	.33	.15	.32	.00	.00	.00	.00	.00	.24
VBAR		1.73	2.38	1.05	2.08	.74	.00	.00	.00	.00	.00	1.60
WDTH		5.58	4.69	5.85	6.38	8.42	.00	.00	.00	.00	.00	6.18
AREA		1.15	.84	1.91	.96	2.69	.00	.00	.00	.00	.00	1.51
STGE		92.61	93.03	95.68	96.45	96.59	.00	.00	.00	.00	.00	94.87
DMAX		.38	.30	.53	.29	.44	.00	.00	.00	.00	.00	.39
WTOT	.4	.00	.00	2.21	.00	2.20	.00	.00	.00	.00	.00	.88
WMAX		.00	.00	2.21	.00	1.77	.00	.00	.00	.00	.00	.80
PTOT		.00	.00	37.85	.00	26.11	.00	.00	.00	.00	.00	12.79
PMAX		.00	.00	37.85	.00	21.03	.00	.00	.00	.00	.00	11.78
WTOT	1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 2.5 CFS

XSEC		1	2	3	4	5						AVG
WETP		6.46	5.13	6.45	8.52	8.83	.00	.00	.00	.00	.00	7.08
DBAR		.25	.25	.38	.16	.37	.00	.00	.00	.00	.00	.28
VBAR		1.55	2.15	1.06	1.82	.80	.00	.00	.00	.00	.00	1.48
WDTH		6.35	4.74	6.11	8.46	8.51	.00	.00	.00	.00	.00	6.83
AREA		1.61	1.16	2.35	1.37	3.12	.00	.00	.00	.00	.00	1.92
STGE		92.68	93.10	95.76	96.50	96.64	.00	.00	.00	.00	.00	94.94

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

DMAX		.45	.37	.61	.34	.49	.00	.00	.00	.00	.00	.45
WTOT	.4	.54	.00	3.00	.00	4.29	.00	.00	.00	.00	.00	1.57
WMAX		.54	.00	3.00	.00	2.69	.00	.00	.00	.00	.00	1.25
PTOT		8.54	.00	49.11	.00	50.39	.00	.00	.00	.00	.00	21.61
PMAX		8.54	.00	49.11	.00	31.61	.00	.00	.00	.00	.00	17.85
WTOT	1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 3.0 CFS

											AVG
XSEC		1	2	3	4	5						
WETP		7.09	6.01	6.83	9.18	8.95	.00	.00	.00	.00	.00	7.61
DBAR		.29	.26	.43	.19	.40	.00	.00	.00	.00	.00	.32
VBAR		1.47	2.07	1.10	1.70	.86	.00	.00	.00	.00	.00	1.44
WDTH		6.95	5.57	6.43	9.11	8.59	.00	.00	.00	.00	.00	7.33
AREA		2.04	1.45	2.73	1.76	3.48	.00	.00	.00	.00	.00	2.29
STGE		92.75	93.16	95.82	96.54	96.69	.00	.00	.00	.00	.00	94.99
DMAX		.52	.43	.67	.38	.54	.00	.00	.00	.00	.00	.51
WTOT	.4	1.76	1.57	3.79	.00	4.80	.00	.00	.00	.00	.00	2.38
WMAX		1.76	1.57	3.79	.00	4.80	.00	.00	.00	.00	.00	2.38
PTOT		25.38	28.25	58.94	.00	55.91	.00	.00	.00	.00	.00	33.70
PMAX		25.38	28.25	58.94	.00	55.91	.00	.00	.00	.00	.00	33.70
WTOT	1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 3.5 CFS

											AVG
XSEC		1	2	3	4	5						
WETP		7.28	6.43	7.16	12.16	9.05	.00	.00	.00	.00	.00	8.42
DBAR		.34	.29	.46	.18	.44	.00	.00	.00	.00	.00	.34
VBAR		1.45	2.03	1.14	1.62	.93	.00	.00	.00	.00	.00	1.43
WDTH		7.11	5.95	6.72	12.09	8.65	.00	.00	.00	.00	.00	8.10
AREA		2.41	1.72	3.07	2.17	3.78	.00	.00	.00	.00	.00	2.63
STGE		92.80	93.21	95.87	96.58	96.72	.00	.00	.00	.00	.00	95.04
DMAX		.57	.48	.72	.42	.57	.00	.00	.00	.00	.00	.55
WTOT	.4	2.57	1.69	4.48	.32	5.36	.00	.00	.00	.00	.00	2.88
WMAX		2.57	1.69	4.48	.32	5.36	.00	.00	.00	.00	.00	2.88
PTOT		36.11	28.42	66.67	2.68	62.02	.00	.00	.00	.00	.00	39.18
PMAX		36.11	28.42	66.67	2.68	62.02	.00	.00	.00	.00	.00	39.18
WTOT	1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 4.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	7.45	6.66	7.43	13.30	9.14	.00	.00	.00	.00	.00	8.80
DBAR	.38	.32	.49	.19	.47	.00	.00	.00	.00	.00	.37
VBAR	1.46	2.03	1.18	1.56	.99	.00	.00	.00	.00	.00	1.44
WDTH	7.25	6.14	6.94	13.22	8.70	.00	.00	.00	.00	.00	8.45
AREA	2.75	1.97	3.38	2.57	4.05	.00	.00	.00	.00	.00	2.94
STGE	92.85	93.25	95.92	96.61	96.75	.00	.00	.00	.00	.00	95.08
DMAX	.62	.52	.77	.45	.60	.00	.00	.00	.00	.00	.59
WTOT .4	4.27	1.79	4.90	.81	7.02	.00	.00	.00	.00	.00	3.76
WMAX	4.27	1.79	4.90	.81	7.02	.00	.00	.00	.00	.00	3.76
PTOT	58.81	29.20	70.52	6.13	80.64	.00	.00	.00	.00	.00	49.06
PMAX	58.81	29.20	70.52	6.13	80.64	.00	.00	.00	.00	.00	49.06
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 5.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	7.73	6.90	7.72	14.11	9.29	.00	.00	.00	.00	.00	9.15
DBAR	.44	.38	.55	.24	.51	.00	.00	.00	.00	.00	.42
VBAR	1.51	2.09	1.28	1.52	1.11	.00	.00	.00	.00	.00	1.50
WDTH	7.49	6.30	7.15	14.01	8.79	.00	.00	.00	.00	.00	8.75
AREA	3.32	2.40	3.90	3.30	4.49	.00	.00	.00	.00	.00	3.48
STGE	92.93	93.32	95.99	96.67	96.80	.00	.00	.00	.00	.00	95.14
DMAX	.70	.59	.84	.51	.65	.00	.00	.00	.00	.00	.66
WTOT .4	5.13	2.61	5.36	3.12	7.52	.00	.00	.00	.00	.00	4.75
WMAX	5.13	1.96	5.36	3.12	7.52	.00	.00	.00	.00	.00	4.62
PTOT	68.48	41.41	74.96	22.30	85.60	.00	.00	.00	.00	.00	58.55
PMAX	68.48	31.17	74.96	22.30	85.60	.00	.00	.00	.00	.00	56.50
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 6.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	7.95	7.59	9.99	14.40	9.94	.00	.00	.00	.00	.00	9.98
DBAR	.50	.40	.47	.28	.52	.00	.00	.00	.00	.00	.43
VBAR	1.58	2.17	1.36	1.53	1.23	.00	.00	.00	.00	.00	1.57
WDTH	7.66	6.94	9.33	14.28	9.37	.00	.00	.00	.00	.00	9.52
AREA	3.80	2.77	4.41	3.93	4.87	.00	.00	.00	.00	.00	3.96

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

STGE	92.99	93.37	96.05	96.71	96.84	.00	.00	.00	.00	.00	95.19
DMAX	.76	.64	.90	.55	.69	.00	.00	.00	.00	.00	.71
WTOT .4	5.48	4.52	5.74	3.79	7.87	.00	.00	.00	.00	.00	5.48
WMAX	5.48	2.35	5.74	3.79	7.87	.00	.00	.00	.00	.00	5.05
PTOT	71.57	65.12	61.54	26.54	83.96	.00	.00	.00	.00	.00	61.75
PMAX	71.57	33.84	61.54	26.54	83.96	.00	.00	.00	.00	.00	55.49
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 7.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	8.11	8.21	10.87	14.64	10.42	.00	.00	.00	.00	.00	10.45
DBAR	.54	.41	.49	.31	.53	.00	.00	.00	.00	.00	.46
VBAR	1.66	2.25	1.42	1.57	1.34	.00	.00	.00	.00	.00	1.65
WDTH	7.75	7.52	10.11	14.50	9.80	.00	.00	.00	.00	.00	9.94
AREA	4.22	3.11	4.92	4.47	5.21	.00	.00	.00	.00	.00	4.39
STGE	93.04	93.42	96.10	96.75	96.88	.00	.00	.00	.00	.00	95.24
DMAX	.81	.69	.95	.59	.73	.00	.00	.00	.00	.00	.76
WTOT .4	5.85	4.67	5.91	4.35	8.04	.00	.00	.00	.00	.00	5.77
WMAX	5.85	4.67	5.91	4.35	8.04	.00	.00	.00	.00	.00	5.77
PTOT	75.50	62.16	58.47	30.02	82.06	.00	.00	.00	.00	.00	61.64
PMAX	75.50	62.16	58.47	30.02	82.06	.00	.00	.00	.00	.00	61.64
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 8.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	8.24	9.23	11.47	14.89	10.76	.00	.00	.00	.00	.00	10.92
DBAR	.58	.41	.51	.34	.55	.00	.00	.00	.00	.00	.48
VBAR	1.75	2.31	1.49	1.62	1.45	.00	.00	.00	.00	.00	1.72
WDTH	7.84	8.49	10.63	14.75	10.10	.00	.00	.00	.00	.00	10.36
AREA	4.58	3.46	5.38	4.94	5.52	.00	.00	.00	.00	.00	4.78
STGE	93.09	93.46	96.15	96.78	96.91	.00	.00	.00	.00	.00	95.28
DMAX	.86	.73	1.00	.62	.76	.00	.00	.00	.00	.00	.79
WTOT .4	6.41	4.71	6.05	5.77	8.18	.00	.00	.00	.00	.00	6.23
WMAX	6.41	4.71	6.05	5.77	8.18	.00	.00	.00	.00	.00	6.23
PTOT	81.85	55.46	56.98	39.15	80.94	.00	.00	.00	.00	.00	62.87
PMAX	81.85	55.46	56.98	39.15	80.94	.00	.00	.00	.00	.00	62.87
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 9.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	8.36	9.33	12.02	15.12	11.10	.00	.00	.00	.00	.00	11.19
DBAR	.62	.44	.52	.36	.56	.00	.00	.00	.00	.00	.50
VBAR	1.83	2.39	1.55	1.68	1.55	.00	.00	.00	.00	.00	1.80
WDTH	7.91	8.55	11.09	14.96	10.41	.00	.00	.00	.00	.00	10.58
AREA	4.91	3.77	5.81	5.37	5.80	.00	.00	.00	.00	.00	5.13
STGE	93.13	93.50	96.19	96.81	96.94	.00	.00	.00	.00	.00	95.31
DMAX	.90	.77	1.04	.65	.79	.00	.00	.00	.00	.00	.83
WTOT .4	6.90	4.74	6.26	6.11	8.29	.00	.00	.00	.00	.00	6.46
WMAX	6.90	4.74	6.26	6.11	8.29	.00	.00	.00	.00	.00	6.46
PTOT	87.26	55.44	56.40	40.85	79.66	.00	.00	.00	.00	.00	63.92
PMAX	87.26	55.44	56.40	40.85	79.66	.00	.00	.00	.00	.00	63.92
WTOT 1.0	.00	.00	.76	.00	.00	.00	.00	.00	.00	.00	.15
WMAX	.00	.00	.45	.00	.00	.00	.00	.00	.00	.00	.09
PTOT	.00	.00	6.81	.00	.00	.00	.00	.00	.00	.00	1.36
PMAX	.00	.00	4.02	.00	.00	.00	.00	.00	.00	.00	.80

FLOW= 10.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	8.59	9.42	12.55	15.32	11.41	.00	.00	.00	.00	.00	11.46
DBAR	.64	.47	.54	.38	.57	.00	.00	.00	.00	.00	.52
VBAR	1.92	2.47	1.61	1.74	1.65	.00	.00	.00	.00	.00	1.88
WDTH	8.10	8.60	11.55	15.15	10.68	.00	.00	.00	.00	.00	10.82
AREA	5.20	4.05	6.21	5.76	6.05	.00	.00	.00	.00	.00	5.45
STGE	93.17	93.53	96.22	96.84	96.96	.00	.00	.00	.00	.00	95.34
DMAX	.94	.80	1.07	.68	.81	.00	.00	.00	.00	.00	.86
WTOT .4	7.01	4.77	6.44	6.32	8.36	.00	.00	.00	.00	.00	6.58
WMAX	7.01	4.77	6.44	6.32	8.36	.00	.00	.00	.00	.00	6.58
PTOT	86.56	55.43	55.76	41.69	78.29	.00	.00	.00	.00	.00	63.54
PMAX	86.56	55.43	55.76	41.69	78.29	.00	.00	.00	.00	.00	63.54
WTOT 1.0	.00	.00	1.47	.00	.00	.00	.00	.00	.00	.00	.29
WMAX	.00	.00	.87	.00	.00	.00	.00	.00	.00	.00	.17
PTOT	.00	.00	12.76	.00	.00	.00	.00	.00	.00	.00	2.55
PMAX	.00	.00	7.53	.00	.00	.00	.00	.00	.00	.00	1.51

FLOW= 15.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	9.62	10.49	15.02	15.98	12.58	.00	.00	.00	.00	.00	12.74
DBAR	.71	.55	.58	.46	.60	.00	.00	.00	.00	.00	.58
VBAR	2.34	2.89	1.89	2.06	2.11	.00	.00	.00	.00	.00	2.26
WDTH	8.99	9.48	13.77	15.79	11.74	.00	.00	.00	.00	.00	11.95

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

AREA		6.41	5.20	7.92	7.29	7.10	.00	.00	.00	.00	.00	6.78
STGE		93.31	93.65	96.36	96.94	97.06	.00	.00	.00	.00	.00	95.46
DMAX		1.08	.92	1.21	.78	.91	.00	.00	.00	.00	.00	.98
WTOT	.4	7.44	6.16	7.07	9.01	8.53	.00	.00	.00	.00	.00	7.64
WMAX		7.44	6.16	7.07	9.01	8.53	.00	.00	.00	.00	.00	7.64
PTOT		82.74	64.94	51.30	57.09	72.67	.00	.00	.00	.00	.00	65.75
PMAX		82.74	64.94	51.30	57.09	72.67	.00	.00	.00	.00	.00	65.75
WTOT	1.0	.79	.00	3.00	.00	.00	.00	.00	.00	.00	.00	.76
WMAX		.79	.00	3.00	.00	.00	.00	.00	.00	.00	.00	.76
PTOT		8.81	.00	21.81	.00	.00	.00	.00	.00	.00	.00	6.13
PMAX		8.81	.00	21.81	.00	.00	.00	.00	.00	.00	.00	6.13

FLOW= 20.0 CFS

XSEC		1	2	3	4	5						AVG
WETP		10.18	10.67	16.25	16.41	12.83	.00	.00	.00	.00	.00	13.27
DBAR		.78	.63	.63	.52	.66	.00	.00	.00	.00	.00	.64
VBAR		2.72	3.31	2.14	2.38	2.54	.00	.00	.00	.00	.00	2.62
WDTH		9.46	9.52	14.82	16.18	11.92	.00	.00	.00	.00	.00	12.38
AREA		7.34	6.04	9.35	8.41	7.88	.00	.00	.00	.00	.00	7.81
STGE		93.41	93.74	96.46	97.01	97.12	.00	.00	.00	.00	.00	95.55
DMAX		1.18	1.01	1.31	.85	.97	.00	.00	.00	.00	.00	1.06
WTOT	.4	7.70	6.59	9.42	12.53	8.65	.00	.00	.00	.00	.00	8.98
WMAX		7.70	6.59	7.44	12.53	8.65	.00	.00	.00	.00	.00	8.58
PTOT		81.34	69.27	63.54	77.43	72.58	.00	.00	.00	.00	.00	72.83
PMAX		81.34	69.27	50.20	77.43	72.58	.00	.00	.00	.00	.00	70.16
WTOT	1.0	2.70	1.53	4.31	.00	.00	.00	.00	.00	.00	.00	1.71
WMAX		2.70	1.53	4.31	.00	.00	.00	.00	.00	.00	.00	1.71
PTOT		28.54	16.10	29.07	.00	.00	.00	.00	.00	.00	.00	14.74
PMAX		28.54	16.10	29.07	.00	.00	.00	.00	.00	.00	.00	14.74

FLOW= 25.0 CFS

XSEC		1	2	3	4	5						AVG
WETP		10.62	10.81	16.40	16.64	13.00	.00	.00	.00	.00	.00	13.49
DBAR		.82	.70	.71	.57	.71	.00	.00	.00	.00	.00	.70
VBAR		3.09	3.73	2.39	2.69	2.94	.00	.00	.00	.00	.00	2.97
WDTH		9.83	9.55	14.84	16.39	12.03	.00	.00	.00	.00	.00	12.53
AREA		8.10	6.70	10.47	9.30	8.50	.00	.00	.00	.00	.00	8.61
STGE		93.49	93.81	96.53	97.06	97.17	.00	.00	.00	.00	.00	95.61
DMAX		1.26	1.08	1.38	.90	1.02	.00	.00	.00	.00	.00	1.13
WTOT	.4	7.83	7.43	10.43	13.54	8.72	.00	.00	.00	.00	.00	9.59
WMAX		7.83	7.43	7.82	13.54	8.72	.00	.00	.00	.00	.00	9.07
PTOT		79.73	77.84	70.26	82.63	72.52	.00	.00	.00	.00	.00	76.60
PMAX		79.73	77.84	52.71	82.63	72.52	.00	.00	.00	.00	.00	73.09
WTOT	1.0	4.82	1.70	4.99	.00	1.65	.00	.00	.00	.00	.00	2.63

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WMAX	4.82	1.70	4.99	.00	1.41	.00	.00	.00	.00	.00	2.59
PTOT	49.04	17.86	33.62	.00	13.68	.00	.00	.00	.00	.00	22.84
PMAX	49.04	17.86	33.62	.00	11.76	.00	.00	.00	.00	.00	22.46

FLOW= 30.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	10.80	11.35	16.52	16.83	13.13	.00	.00	.00	.00	.00	13.73
DBAR	.88	.73	.77	.61	.74	.00	.00	.00	.00	.00	.74
VBAR	3.44	4.14	2.64	2.99	3.33	.00	.00	.00	.00	.00	3.31
WDTH	9.92	9.99	14.86	16.56	12.12	.00	.00	.00	.00	.00	12.69
AREA	8.73	7.25	11.38	10.03	9.01	.00	.00	.00	.00	.00	9.28
STGE	93.55	93.87	96.59	97.11	97.22	.00	.00	.00	.00	.00	95.67
DMAX	1.32	1.14	1.44	.95	1.07	.00	.00	.00	.00	.00	1.18
WTOT .4	8.00	8.50	11.16	14.25	8.96	.00	.00	.00	.00	.00	10.18
WMAX	8.00	8.50	8.14	14.25	8.76	.00	.00	.00	.00	.00	9.53
PTOT	80.72	85.15	75.08	86.09	73.94	.00	.00	.00	.00	.00	80.19
PMAX	80.72	85.15	54.76	86.09	72.32	.00	.00	.00	.00	.00	75.81
WTOT 1.0	5.29	1.85	5.38	.00	3.05	.00	.00	.00	.00	.00	3.11
WMAX	5.29	1.85	5.38	.00	2.17	.00	.00	.00	.00	.00	2.94
PTOT	53.30	18.48	36.17	.00	25.15	.00	.00	.00	.00	.00	26.62
PMAX	53.30	18.48	36.17	.00	17.92	.00	.00	.00	.00	.00	25.17

FLOW= 40.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	11.10	12.52	16.94	17.13	13.34	.00	.00	.00	.00	.00	14.21
DBAR	.97	.74	.85	.67	.80	.00	.00	.00	.00	.00	.80
VBAR	4.11	4.89	3.12	3.57	4.08	.00	.00	.00	.00	.00	3.95
WDTH	10.09	11.00	15.16	16.82	12.26	.00	.00	.00	.00	.00	13.06
AREA	9.74	8.18	12.83	11.21	9.81	.00	.00	.00	.00	.00	10.35
STGE	93.65	93.96	96.69	97.18	97.28	.00	.00	.00	.00	.00	95.75
DMAX	1.42	1.23	1.54	1.02	1.13	.00	.00	.00	.00	.00	1.27
WTOT .4	8.65	8.64	12.42	14.69	9.81	.00	.00	.00	.00	.00	10.84
WMAX	8.65	8.64	8.66	14.69	8.83	.00	.00	.00	.00	.00	9.90
PTOT	85.78	78.60	81.94	87.35	80.04	.00	.00	.00	.00	.00	82.74
PMAX	85.78	78.60	57.12	87.35	72.03	.00	.00	.00	.00	.00	76.18
WTOT 1.0	5.98	4.31	5.86	.23	4.77	.00	.00	.00	.00	.00	4.23
WMAX	5.98	2.23	5.86	.23	4.77	.00	.00	.00	.00	.00	3.81
PTOT	59.28	39.16	38.68	1.39	38.90	.00	.00	.00	.00	.00	35.48
PMAX	59.28	20.26	38.68	1.39	38.90	.00	.00	.00	.00	.00	31.70

FLOW= 50.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	11.55	12.95	17.32	17.34	13.51	.00	.00	.00	.00	.00	14.53
DBAR	1.01	.79	.90	.71	.84	.00	.00	.00	.00	.00	.85
VBAR	4.74	5.59	3.58	4.12	4.79	.00	.00	.00	.00	.00	4.56

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WDTH		10.48	11.36	15.46	17.00	12.37	.00	.00	.00	.00	.00	13.33
AREA		10.54	8.95	13.98	12.13	10.45	.00	.00	.00	.00	.00	11.21
STGE		93.73	94.03	96.76	97.23	97.33	.00	.00	.00	.00	.00	95.82
DMAX		1.50	1.30	1.61	1.07	1.18	.00	.00	.00	.00	.00	1.33
WTOT	.4	9.10	9.47	14.80	15.10	10.35	.00	.00	.00	.00	.00	11.76
WMAX		9.10	9.47	14.80	15.10	8.96	.00	.00	.00	.00	.00	11.49
PTOT		86.81	83.38	95.76	88.82	83.67	.00	.00	.00	.00	.00	87.69
PMAX		86.81	83.38	95.76	88.82	72.40	.00	.00	.00	.00	.00	85.43
WTOT	1.0	6.90	4.68	6.14	1.05	5.62	.00	.00	.00	.00	.00	4.88
WMAX		6.90	4.68	6.14	1.05	5.62	.00	.00	.00	.00	.00	4.88
PTOT		65.89	41.21	39.71	6.19	45.46	.00	.00	.00	.00	.00	39.69
PMAX		65.89	41.21	39.71	6.19	45.46	.00	.00	.00	.00	.00	39.69

FLOW= 60.0 CFS

XSEC		1	2	3	4	5						AVG
WETP		11.92	13.13	17.58	17.51	13.72	.00	.00	.00	.00	.00	14.77
DBAR		1.04	.84	.95	.75	.87	.00	.00	.00	.00	.00	.89
VBAR		5.35	6.25	4.02	4.65	5.47	.00	.00	.00	.00	.00	5.15
WDTH		10.80	11.47	15.65	17.15	12.54	.00	.00	.00	.00	.00	13.52
AREA		11.22	9.60	14.94	12.89	10.97	.00	.00	.00	.00	.00	11.93
STGE		93.80	94.08	96.83	97.27	97.37	.00	.00	.00	.00	.00	95.87
DMAX		1.57	1.35	1.68	1.11	1.22	.00	.00	.00	.00	.00	1.39
WTOT	.4	9.40	9.49	14.82	15.43	10.83	.00	.00	.00	.00	.00	11.99
WMAX		9.40	9.49	14.82	15.43	9.06	.00	.00	.00	.00	.00	11.64
PTOT		86.98	82.75	94.65	89.95	86.36	.00	.00	.00	.00	.00	88.14
PMAX		86.98	82.75	94.65	89.95	72.23	.00	.00	.00	.00	.00	85.31
WTOT	1.0	7.10	4.73	6.46	3.22	7.25	.00	.00	.00	.00	.00	5.75
WMAX		7.10	4.73	6.46	3.22	7.25	.00	.00	.00	.00	.00	5.75
PTOT		65.71	41.21	41.27	18.78	57.81	.00	.00	.00	.00	.00	44.95
PMAX		65.71	41.21	41.27	18.78	57.81	.00	.00	.00	.00	.00	44.95

FLOW= 70.0 CFS

XSEC		1	2	3	4	5						AVG
WETP		12.81	13.24	17.80	17.66	14.02	.00	.00	.00	.00	.00	15.11
DBAR		1.01	.88	1.00	.78	.89	.00	.00	.00	.00	.00	.91
VBAR		5.92	6.90	4.44	5.17	6.13	.00	.00	.00	.00	.00	5.71
WDTH		11.65	11.52	15.82	17.28	12.81	.00	.00	.00	.00	.00	13.82
AREA		11.82	10.15	15.76	13.54	11.42	.00	.00	.00	.00	.00	12.54
STGE		93.85	94.13	96.83	97.31	97.41	.00	.00	.00	.00	.00	95.92
DMAX		1.62	1.40	1.73	1.15	1.26	.00	.00	.00	.00	.00	1.43
WTOT	.4	9.65	9.51	14.83	15.65	11.24	.00	.00	.00	.00	.00	12.18
WMAX		9.65	9.51	14.83	15.65	9.15	.00	.00	.00	.00	.00	11.76
PTOT		82.80	82.54	93.73	90.56	87.73	.00	.00	.00	.00	.00	87.47
PMAX		82.80	82.54	93.73	90.56	71.40	.00	.00	.00	.00	.00	84.21

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WTOT	1.0	7.26	5.27	6.76	3.79	7.59	.00	.00	.00	.00	.00	6.13
WMAX		7.26	5.27	6.76	3.79	7.59	.00	.00	.00	.00	.00	6.13
PTOT		62.31	45.76	42.74	21.92	59.24	.00	.00	.00	.00	.00	46.40
PMAX		62.31	45.76	42.74	21.92	59.24	.00	.00	.00	.00	.00	46.40

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

COMPUTED VALUES

FLOW= 1.5 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	5.54	5.72	8.45	.00	.00	.00	.00	.00	6.57
DBAR	.00	.00	.26	.09	.26	.00	.00	.00	.00	.00	.20
VBAR	.00	.00	1.10	2.79	.70	.00	.00	.00	.00	.00	1.53
WDTH	.00	.00	5.35	5.69	8.24	.00	.00	.00	.00	.00	6.43
AREA	.00	.00	1.37	.54	2.14	.00	.00	.00	.00	.00	1.35
STGE	.00	.00	95.59	96.38	96.53	.00	.00	.00	.00	.00	96.16
DMAX	.00	.00	.44	.22	.38	.00	.00	.00	.00	.00	.34
WTOT .4	.00	.00	.77	.00	.00	.00	.00	.00	.00	.00	.26
WMAX	.00	.00	.45	.00	.00	.00	.00	.00	.00	.00	.15
PTOT	.00	.00	14.34	.00	.00	.00	.00	.00	.00	.00	4.78
PMAX	.00	.00	8.46	.00	.00	.00	.00	.00	.00	.00	2.82
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 2.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	6.13	6.44	8.69	.00	.00	.00	.00	.00	7.08
DBAR	.00	.00	.33	.15	.32	.00	.00	.00	.00	.00	.27
VBAR	.00	.00	1.05	2.08	.74	.00	.00	.00	.00	.00	1.29
WDTH	.00	.00	5.85	6.38	8.42	.00	.00	.00	.00	.00	6.88
AREA	.00	.00	1.91	.96	2.69	.00	.00	.00	.00	.00	1.85
STGE	.00	.00	95.68	96.45	96.59	.00	.00	.00	.00	.00	96.24
DMAX	.00	.00	.53	.29	.44	.00	.00	.00	.00	.00	.42
WTOT .4	.00	.00	2.21	.00	2.20	.00	.00	.00	.00	.00	1.47
WMAX	.00	.00	2.21	.00	1.77	.00	.00	.00	.00	.00	1.33
PTOT	.00	.00	37.85	.00	26.11	.00	.00	.00	.00	.00	21.32
PMAX	.00	.00	37.85	.00	21.03	.00	.00	.00	.00	.00	19.63
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 2.5 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	6.45	8.52	8.83	.00	.00	.00	.00	.00	7.93
DBAR	.00	.00	.38	.16	.37	.00	.00	.00	.00	.00	.30
VBAR	.00	.00	1.06	1.82	.80	.00	.00	.00	.00	.00	1.23
WDTH	.00	.00	6.11	8.46	8.51	.00	.00	.00	.00	.00	7.69
AREA	.00	.00	2.35	1.37	3.12	.00	.00	.00	.00	.00	2.28
STGE	.00	.00	95.76	96.50	96.64	.00	.00	.00	.00	.00	96.30

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

DMAX	.00	.00	.61	.34	.49	.00	.00	.00	.00	.00	.48
WTOT .4	.00	.00	3.00	.00	4.29	.00	.00	.00	.00	.00	2.43
WMAX	.00	.00	3.00	.00	2.69	.00	.00	.00	.00	.00	1.90
PTOT	.00	.00	49.11	.00	50.39	.00	.00	.00	.00	.00	33.17
PMAX	.00	.00	49.11	.00	31.61	.00	.00	.00	.00	.00	26.91
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 3.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	6.83	9.18	8.95	.00	.00	.00	.00	.00	8.32
DBAR	.00	.00	.43	.19	.40	.00	.00	.00	.00	.00	.34
VBAR	.00	.00	1.10	1.70	.86	.00	.00	.00	.00	.00	1.22
WDTH	.00	.00	6.43	9.11	8.59	.00	.00	.00	.00	.00	8.04
AREA	.00	.00	2.73	1.76	3.48	.00	.00	.00	.00	.00	2.66
STGE	.00	.00	95.82	96.54	96.69	.00	.00	.00	.00	.00	96.35
DMAX	.00	.00	.67	.38	.54	.00	.00	.00	.00	.00	.53
WTOT .4	.00	.00	3.79	.00	4.80	.00	.00	.00	.00	.00	2.86
WMAX	.00	.00	3.79	.00	4.80	.00	.00	.00	.00	.00	2.86
PTOT	.00	.00	58.94	.00	55.91	.00	.00	.00	.00	.00	38.28
PMAX	.00	.00	58.94	.00	55.91	.00	.00	.00	.00	.00	38.28
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 3.5 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	7.16	12.16	9.05	.00	.00	.00	.00	.00	9.46
DBAR	.00	.00	.46	.18	.44	.00	.00	.00	.00	.00	.36
VBAR	.00	.00	1.14	1.62	.93	.00	.00	.00	.00	.00	1.23
WDTH	.00	.00	6.72	12.09	8.65	.00	.00	.00	.00	.00	9.15
AREA	.00	.00	3.07	2.17	3.78	.00	.00	.00	.00	.00	3.01
STGE	.00	.00	95.87	96.58	96.72	.00	.00	.00	.00	.00	96.39
DMAX	.00	.00	.72	.42	.57	.00	.00	.00	.00	.00	.57
WTOT .4	.00	.00	4.48	.32	5.36	.00	.00	.00	.00	.00	3.39
WMAX	.00	.00	4.48	.32	5.36	.00	.00	.00	.00	.00	3.39
PTOT	.00	.00	66.67	2.68	62.02	.00	.00	.00	.00	.00	43.79
PMAX	.00	.00	66.67	2.68	62.02	.00	.00	.00	.00	.00	43.79
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 4.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	7.43	13.30	9.14	.00	.00	.00	.00	.00	9.96
DBAR	.00	.00	.49	.19	.47	.00	.00	.00	.00	.00	.38
VBAR	.00	.00	1.18	1.56	.99	.00	.00	.00	.00	.00	1.24
WDTH	.00	.00	6.94	13.22	8.70	.00	.00	.00	.00	.00	9.62
AREA	.00	.00	3.38	2.57	4.05	.00	.00	.00	.00	.00	3.33
STGE	.00	.00	95.92	96.61	96.75	.00	.00	.00	.00	.00	96.43
DMAX	.00	.00	.77	.45	.60	.00	.00	.00	.00	.00	.61
WTOT .4	.00	.00	4.90	.81	7.02	.00	.00	.00	.00	.00	4.24
WMAX	.00	.00	4.90	.81	7.02	.00	.00	.00	.00	.00	4.24
PTOT	.00	.00	70.52	6.13	80.64	.00	.00	.00	.00	.00	52.43
PMAX	.00	.00	70.52	6.13	80.64	.00	.00	.00	.00	.00	52.43
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 5.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	7.72	14.11	9.29	.00	.00	.00	.00	.00	10.38
DBAR	.00	.00	.55	.24	.51	.00	.00	.00	.00	.00	.43
VBAR	.00	.00	1.28	1.52	1.11	.00	.00	.00	.00	.00	1.30
WDTH	.00	.00	7.15	14.01	8.79	.00	.00	.00	.00	.00	9.98
AREA	.00	.00	3.90	3.30	4.49	.00	.00	.00	.00	.00	3.90
STGE	.00	.00	95.99	96.67	96.80	.00	.00	.00	.00	.00	96.49
DMAX	.00	.00	.84	.51	.65	.00	.00	.00	.00	.00	.67
WTOT .4	.00	.00	5.36	3.12	7.52	.00	.00	.00	.00	.00	5.34
WMAX	.00	.00	5.36	3.12	7.52	.00	.00	.00	.00	.00	5.34
PTOT	.00	.00	74.96	22.30	85.60	.00	.00	.00	.00	.00	60.96
PMAX	.00	.00	74.96	22.30	85.60	.00	.00	.00	.00	.00	60.96
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 6.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	9.99	14.40	9.94	.00	.00	.00	.00	.00	11.45
DBAR	.00	.00	.47	.28	.52	.00	.00	.00	.00	.00	.42
VBAR	.00	.00	1.36	1.53	1.23	.00	.00	.00	.00	.00	1.37
WDTH	.00	.00	9.33	14.28	9.37	.00	.00	.00	.00	.00	11.00
AREA	.00	.00	4.41	3.93	4.87	.00	.00	.00	.00	.00	4.41

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

STGE	.00	.00	96.05	96.71	96.84	.00	.00	.00	.00	.00	96.54
DMAX	.00	.00	.90	.55	.69	.00	.00	.00	.00	.00	.72
WTOT .4	.00	.00	5.74	3.79	7.87	.00	.00	.00	.00	.00	5.80
WMAX	.00	.00	5.74	3.79	7.87	.00	.00	.00	.00	.00	5.80
PTOT	.00	.00	61.54	26.54	83.96	.00	.00	.00	.00	.00	57.35
PMAX	.00	.00	61.54	26.54	83.96	.00	.00	.00	.00	.00	57.35
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 7.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	10.87	14.64	10.42	.00	.00	.00	.00	.00	11.98
DBAR	.00	.00	.49	.31	.53	.00	.00	.00	.00	.00	.44
VBAR	.00	.00	1.42	1.57	1.34	.00	.00	.00	.00	.00	1.44
WDTH	.00	.00	10.11	14.50	9.80	.00	.00	.00	.00	.00	11.47
AREA	.00	.00	4.92	4.47	5.21	.00	.00	.00	.00	.00	4.87
STGE	.00	.00	96.10	96.75	96.88	.00	.00	.00	.00	.00	96.58
DMAX	.00	.00	.95	.59	.73	.00	.00	.00	.00	.00	.76
WTOT .4	.00	.00	5.91	4.35	8.04	.00	.00	.00	.00	.00	6.10
WMAX	.00	.00	5.91	4.35	8.04	.00	.00	.00	.00	.00	6.10
PTOT	.00	.00	58.47	30.02	82.06	.00	.00	.00	.00	.00	56.85
PMAX	.00	.00	58.47	30.02	82.06	.00	.00	.00	.00	.00	56.85
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 8.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	11.47	14.89	10.76	.00	.00	.00	.00	.00	12.38
DBAR	.00	.00	.51	.34	.55	.00	.00	.00	.00	.00	.46
VBAR	.00	.00	1.49	1.62	1.45	.00	.00	.00	.00	.00	1.52
WDTH	.00	.00	10.63	14.75	10.10	.00	.00	.00	.00	.00	11.82
AREA	.00	.00	5.38	4.94	5.52	.00	.00	.00	.00	.00	5.28
STGE	.00	.00	96.15	96.78	96.91	.00	.00	.00	.00	.00	96.61
DMAX	.00	.00	1.00	.62	.76	.00	.00	.00	.00	.00	.79
WTOT .4	.00	.00	6.05	5.77	8.18	.00	.00	.00	.00	.00	6.67
WMAX	.00	.00	6.05	5.77	8.18	.00	.00	.00	.00	.00	6.67
PTOT	.00	.00	56.98	39.15	80.94	.00	.00	.00	.00	.00	59.02
PMAX	.00	.00	56.98	39.15	80.94	.00	.00	.00	.00	.00	59.02
WTOT 1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

PTOT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PMAX	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

FLOW= 9.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	12.02	15.12	11.10	.00	.00	.00	.00	.00	12.75
DBAR	.00	.00	.52	.36	.56	.00	.00	.00	.00	.00	.48
VBAR	.00	.00	1.55	1.68	1.55	.00	.00	.00	.00	.00	1.59
WDTH	.00	.00	11.09	14.96	10.41	.00	.00	.00	.00	.00	12.15
AREA	.00	.00	5.81	5.37	5.80	.00	.00	.00	.00	.00	5.66
STGE	.00	.00	96.19	96.81	96.94	.00	.00	.00	.00	.00	96.65
DMAX	.00	.00	1.04	.65	.79	.00	.00	.00	.00	.00	.83
WTOT .4	.00	.00	6.26	6.11	8.29	.00	.00	.00	.00	.00	6.89
WMAX	.00	.00	6.26	6.11	8.29	.00	.00	.00	.00	.00	6.89
PTOT	.00	.00	56.40	40.85	79.66	.00	.00	.00	.00	.00	58.97
PMAX	.00	.00	56.40	40.85	79.66	.00	.00	.00	.00	.00	58.97
WTOT 1.0	.00	.00	.76	.00	.00	.00	.00	.00	.00	.00	.25
WMAX	.00	.00	.45	.00	.00	.00	.00	.00	.00	.00	.15
PTOT	.00	.00	6.81	.00	.00	.00	.00	.00	.00	.00	2.27
PMAX	.00	.00	4.02	.00	.00	.00	.00	.00	.00	.00	1.34

FLOW= 10.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	12.55	15.32	11.41	.00	.00	.00	.00	.00	13.09
DBAR	.00	.00	.54	.38	.57	.00	.00	.00	.00	.00	.49
VBAR	.00	.00	1.61	1.74	1.65	.00	.00	.00	.00	.00	1.67
WDTH	.00	.00	11.55	15.15	10.68	.00	.00	.00	.00	.00	12.46
AREA	.00	.00	6.21	5.76	6.05	.00	.00	.00	.00	.00	6.01
STGE	.00	.00	96.22	96.84	96.96	.00	.00	.00	.00	.00	96.67
DMAX	.00	.00	1.07	.68	.81	.00	.00	.00	.00	.00	.85
WTOT .4	.00	.00	6.44	6.32	8.36	.00	.00	.00	.00	.00	7.04
WMAX	.00	.00	6.44	6.32	8.36	.00	.00	.00	.00	.00	7.04
PTOT	.00	.00	55.76	41.69	78.29	.00	.00	.00	.00	.00	58.58
PMAX	.00	.00	55.76	41.69	78.29	.00	.00	.00	.00	.00	58.58
WTOT 1.0	.00	.00	1.47	.00	.00	.00	.00	.00	.00	.00	.49
WMAX	.00	.00	.87	.00	.00	.00	.00	.00	.00	.00	.29
PTOT	.00	.00	12.76	.00	.00	.00	.00	.00	.00	.00	4.25
PMAX	.00	.00	7.53	.00	.00	.00	.00	.00	.00	.00	2.51

FLOW= 15.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	15.02	15.98	12.58	.00	.00	.00	.00	.00	14.53
DBAR	.00	.00	.58	.46	.60	.00	.00	.00	.00	.00	.55
VBAR	.00	.00	1.89	2.06	2.11	.00	.00	.00	.00	.00	2.02
WDTH	.00	.00	13.77	15.79	11.74	.00	.00	.00	.00	.00	13.77

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

AREA	.00	.00	7.92	7.29	7.10	.00	.00	.00	.00	.00	7.44
STGE	.00	.00	96.36	96.94	97.06	.00	.00	.00	.00	.00	96.78
DMAX	.00	.00	1.21	.78	.91	.00	.00	.00	.00	.00	.96
WTOT .4	.00	.00	7.07	9.01	8.53	.00	.00	.00	.00	.00	8.20
WMAX	.00	.00	7.07	9.01	8.53	.00	.00	.00	.00	.00	8.20
PTOT	.00	.00	51.30	57.09	72.67	.00	.00	.00	.00	.00	60.35
PMAX	.00	.00	51.30	57.09	72.67	.00	.00	.00	.00	.00	60.35
WTOT 1.0	.00	.00	3.00	.00	.00	.00	.00	.00	.00	.00	1.00
WMAX	.00	.00	3.00	.00	.00	.00	.00	.00	.00	.00	1.00
PTOT	.00	.00	21.81	.00	.00	.00	.00	.00	.00	.00	7.27
PMAX	.00	.00	21.81	.00	.00	.00	.00	.00	.00	.00	7.27

FLOW= 20.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	16.25	16.41	12.83	.00	.00	.00	.00	.00	15.16
DBAR	.00	.00	.63	.52	.66	.00	.00	.00	.00	.00	.60
VBAR	.00	.00	2.14	2.38	2.54	.00	.00	.00	.00	.00	2.35
WDTH	.00	.00	14.82	16.18	11.92	.00	.00	.00	.00	.00	14.31
AREA	.00	.00	9.35	8.41	7.88	.00	.00	.00	.00	.00	8.55
STGE	.00	.00	96.46	97.01	97.12	.00	.00	.00	.00	.00	96.86
DMAX	.00	.00	1.31	.85	.97	.00	.00	.00	.00	.00	1.04
WTOT .4	.00	.00	9.42	12.53	8.65	.00	.00	.00	.00	.00	10.20
WMAX	.00	.00	7.44	12.53	8.65	.00	.00	.00	.00	.00	9.54
PTOT	.00	.00	63.54	77.43	72.58	.00	.00	.00	.00	.00	71.18
PMAX	.00	.00	50.20	77.43	72.58	.00	.00	.00	.00	.00	66.74
WTOT 1.0	.00	.00	4.31	.00	.00	.00	.00	.00	.00	.00	1.44
WMAX	.00	.00	4.31	.00	.00	.00	.00	.00	.00	.00	1.44
PTOT	.00	.00	29.07	.00	.00	.00	.00	.00	.00	.00	9.69
PMAX	.00	.00	29.07	.00	.00	.00	.00	.00	.00	.00	9.69

FLOW= 25.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	16.40	16.64	13.00	.00	.00	.00	.00	.00	15.34
DBAR	.00	.00	.71	.57	.71	.00	.00	.00	.00	.00	.66
VBAR	.00	.00	2.39	2.69	2.94	.00	.00	.00	.00	.00	2.67
WDTH	.00	.00	14.84	16.39	12.03	.00	.00	.00	.00	.00	14.42
AREA	.00	.00	10.47	9.30	8.50	.00	.00	.00	.00	.00	9.42
STGE	.00	.00	96.53	97.06	97.17	.00	.00	.00	.00	.00	96.92
DMAX	.00	.00	1.38	.90	1.02	.00	.00	.00	.00	.00	1.10
WTOT .4	.00	.00	10.43	13.54	8.72	.00	.00	.00	.00	.00	10.90
WMAX	.00	.00	7.82	13.54	8.72	.00	.00	.00	.00	.00	10.03
PTOT	.00	.00	70.26	82.63	72.52	.00	.00	.00	.00	.00	75.14
PMAX	.00	.00	52.71	82.63	72.52	.00	.00	.00	.00	.00	69.29
WTOT 1.0	.00	.00	4.99	.00	1.65	.00	.00	.00	.00	.00	2.21

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WMAX	.00	.00	4.99	.00	1.41	.00	.00	.00	.00	.00	2.14
PTOT	.00	.00	33.62	.00	13.68	.00	.00	.00	.00	.00	15.77
PMAX	.00	.00	33.62	.00	11.76	.00	.00	.00	.00	.00	15.13

FLOW= 30.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	16.52	16.83	13.13	.00	.00	.00	.00	.00	15.49
DBAR	.00	.00	.77	.61	.74	.00	.00	.00	.00	.00	.70
VBAR	.00	.00	2.64	2.99	3.33	.00	.00	.00	.00	.00	2.99
WDTH	.00	.00	14.86	16.56	12.12	.00	.00	.00	.00	.00	14.51
AREA	.00	.00	11.38	10.03	9.01	.00	.00	.00	.00	.00	10.14
STGE	.00	.00	96.59	97.11	97.22	.00	.00	.00	.00	.00	96.97
DMAX	.00	.00	1.44	.95	1.07	.00	.00	.00	.00	.00	1.15
WTOT .4	.00	.00	11.16	14.25	8.96	.00	.00	.00	.00	.00	11.46
WMAX	.00	.00	8.14	14.25	8.76	.00	.00	.00	.00	.00	10.38
PTOT	.00	.00	75.08	86.09	73.94	.00	.00	.00	.00	.00	78.37
PMAX	.00	.00	54.76	86.09	72.32	.00	.00	.00	.00	.00	71.06
WTOT 1.0	.00	.00	5.38	.00	3.05	.00	.00	.00	.00	.00	2.81
WMAX	.00	.00	5.38	.00	2.17	.00	.00	.00	.00	.00	2.52
PTOT	.00	.00	36.17	.00	25.15	.00	.00	.00	.00	.00	20.44
PMAX	.00	.00	36.17	.00	17.92	.00	.00	.00	.00	.00	18.03

FLOW= 40.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	16.94	17.13	13.34	.00	.00	.00	.00	.00	15.80
DBAR	.00	.00	.85	.67	.80	.00	.00	.00	.00	.00	.77
VBAR	.00	.00	3.12	3.57	4.08	.00	.00	.00	.00	.00	3.59
WDTH	.00	.00	15.16	16.82	12.26	.00	.00	.00	.00	.00	14.75
AREA	.00	.00	12.83	11.21	9.81	.00	.00	.00	.00	.00	11.28
STGE	.00	.00	96.69	97.18	97.28	.00	.00	.00	.00	.00	97.05
DMAX	.00	.00	1.54	1.02	1.13	.00	.00	.00	.00	.00	1.23
WTOT .4	.00	.00	12.42	14.69	9.81	.00	.00	.00	00	.00	12.31
WMAX	.00	.00	8.66	14.69	8.83	.00	.00	.00	.00	.00	10.73
PTOT	.00	.00	81.94	87.35	80.04	.00	.00	.00	.00	.00	83.11
PMAX	.00	.00	57.12	87.35	72.03	.00	.00	.00	.00	.00	72.17
WTOT 1.0	.00	.00	5.86	.23	4.77	.00	.00	.00	.00	.00	3.62
WMAX	.00	.00	5.86	.23	4.77	.00	.00	.00	.00	.00	3.62
PTOT	.00	.00	38.68	1.39	38.90	.00	.00	.00	.00	.00	26.32
PMAX	.00	.00	38.68	1.39	38.90	.00	.00	.00	.00	.00	26.32

FLOW= 50.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	17.32	17.34	13.51	.00	.00	.00	.00	.00	16.05
DBAR	.00	.00	.90	.71	.84	.00	.00	.00	.00	.00	.82
VBAR	.00	.00	3.58	4.12	4.79	.00	.00	.00	.00	.00	4.16

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WDTH	.00	.00	15.46	17.00	12.37	.00	.00	.00	.00	.00	14.94
AREA	.00	.00	13.98	12.13	10.45	.00	.00	.00	.00	.00	12.19
STGE	.00	.00	96.76	97.23	97.33	.00	.00	.00	.00	.00	97.11
DMAX	.00	.00	1.61	1.07	1.18	.00	.00	.00	.00	.00	1.29
WTOT .4	.00	.00	14.80	15.10	10.35	.00	.00	.00	.00	.00	13.42
WMAX	.00	.00	14.80	15.10	8.96	.00	.00	.00	.00	.00	12.95
PTOT	.00	.00	95.76	88.82	83.67	.00	.00	.00	.00	.00	89.41
PMAX	.00	.00	95.76	88.82	72.40	.00	.00	.00	.00	.00	85.66
WTOT 1.0	.00	.00	6.14	1.05	5.62	.00	.00	.00	.00	.00	4.27
WMAX	.00	.00	6.14	1.05	5.62	.00	.00	.00	.00	.00	4.27
PTOT	.00	.00	39.71	6.19	45.46	.00	.00	.00	.00	.00	30.45
PMAX	.00	.00	39.71	6.19	45.46	.00	.00	.00	.00	.00	30.45

FLOW= 60.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	17.58	17.51	13.72	.00	.00	.00	.00	.00	16.27
DBAR	.00	.00	.95	.75	.87	.00	.00	.00	.00	.00	.86
VBAR	.00	.00	4.02	4.65	5.47	.00	.00	.00	.00	.00	4.71
WDTH	.00	.00	15.65	17.15	12.54	.00	.00	.00	.00	.00	15.12
AREA	.00	.00	14.94	12.89	10.97	.00	.00	.00	.00	.00	12.94
STGE	.00	.00	96.83	97.27	97.37	.00	.00	.00	.00	.00	97.16
DMAX	.00	.00	1.68	1.11	1.22	.00	.00	.00	.00	.00	1.34
WTOT .4	.00	.00	14.82	15.43	10.83	.00	.00	.00	.00	.00	13.69
WMAX	.00	.00	14.82	15.43	9.06	.00	.00	.00	.00	.00	13.10
PTOT	.00	.00	94.65	89.95	86.36	.00	.00	.00	.00	.00	90.32
PMAX	.00	.00	94.65	89.95	72.23	.00	.00	.00	.00	.00	85.61
WTOT 1.0	.00	.00	6.46	3.22	7.25	.00	.00	.00	.00	.00	5.64
WMAX	.00	.00	6.46	3.22	7.25	.00	.00	.00	.00	.00	5.64
PTOT	.00	.00	41.27	18.78	57.81	.00	.00	.00	.00	.00	39.29
PMAX	.00	.00	41.27	18.78	57.81	.00	.00	.00	.00	.00	39.29

FLOW= 70.0 CFS

XSEC	1	2	3	4	5						AVG
WETP	.00	.00	17.80	17.66	14.02	.00	.00	.00	.00	.00	16.49
DBAR	.00	.00	1.00	.78	.89	.00	.00	.00	.00	.00	.89
VBAR	.00	.00	4.44	5.17	6.13	.00	.00	.00	.00	.00	5.25
WDTH	.00	.00	15.82	17.28	12.81	.00	.00	.00	.00	.00	15.30
AREA	.00	.00	15.76	13.54	11.42	.00	.00	.00	.00	.00	13.58
STGE	.00	.00	96.88	97.31	97.41	.00	.00	.00	.00	.00	97.20
DMAX	.00	.00	1.73	1.15	1.26	.00	.00	.00	.00	.00	1.38
WTOT .4	.00	.00	14.83	15.65	11.24	.00	.00	.00	.00	.00	13.91
WMAX	.00	.00	14.83	15.65	9.15	.00	.00	.00	.00	.00	13.21
PTOT	.00	.00	93.73	90.56	87.73	.00	.00	.00	.00	.00	90.67
PMAX	.00	.00	93.73	90.56	71.40	.00	.00	.00	.00	.00	85.23

BEAR CREEK - BIG HOLE DRAINAGE - SW,SE, SEC 34, T2N, R12W

WTOT 1.0	.00	.00	6.76	3.79	7.59	.00	.00	.00	.00	.00	6.05
WMAX	.00	.00	6.76	3.79	7.59	.00	.00	.00	.00	.00	6.05
PTOT	.00	.00	42.74	21.92	59.24	.00	.00	.00	.00	.00	41.30
PMAX	.00	.00	42.74	21.92	59.24	.00	.00	.00	.00	.00	41.30